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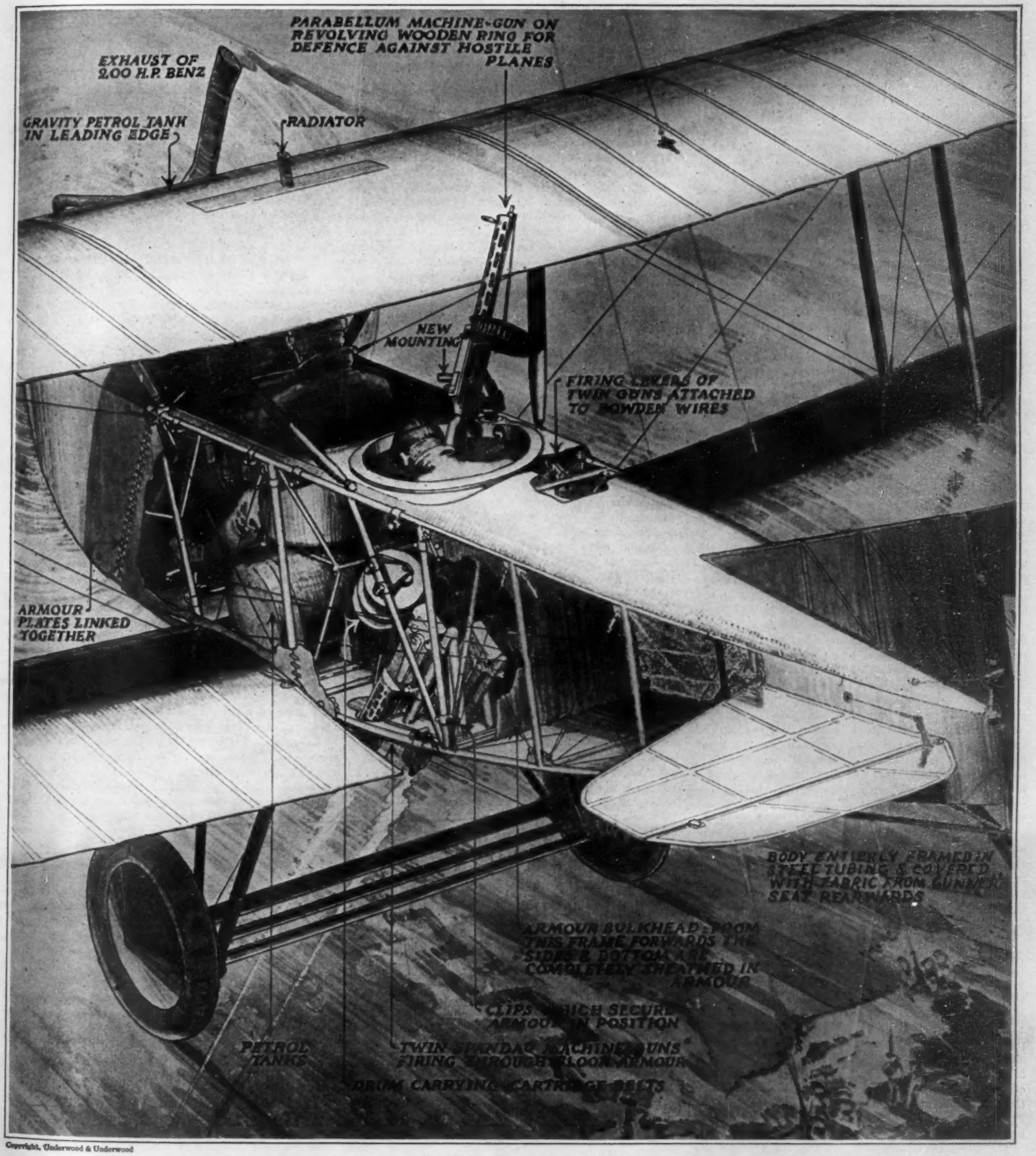
PARABELLUM MACHINE-GUN ON REVOLVING WOODEN RING FOR DEFENCE AGAINST HOSTILE PLANES
EXHAUST OF 200 H.P. BENZ
GRAVITY PETROL TANK IN LEADING EDGE
RADIATOR
NEW MOUNTING
FIRING LEVERS OF TWIN GUNS ATTACHED TO BOWDEN WIRES
ARMOUR PLATES LINKED TOGETHER
BODY ENTIRELY FRAMED IN STEEL TUBING & COVERED WITH FABRIC FROM GUNNER'S SEAT REARWARDS
ARMOUR BULKHEAD: FROM THIS FRAME FORWARDS THE SIDES & BOTTOM ARE COMPLETELY SHEATHED IN ARMOUR
CLIPS WHICH SECURE ARMOUR IN POSITION
PETROL TANKS
TWIN SPANDAU MACHINE-GUNS FIRING THROUGH FLOOR ARMOUR
DRUM CARRYING CARTRIDGE BELTS

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Armored German two-seater plane especially designed for firing on Allied troops on the march. **[See page 461]**

SCIENTIFIC AMERICAN

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

Abolish the Submarine

WHEN the naval section of the Peace Conference settles down to its work, we suggest that one of the first, if not the very first, subjects to be considered should be the placing of a ban upon the construction and use of the submarine. This should be done, first, on the ground that, as a lawful weapon of war, it has failed of its purpose; second, that as an instrument of piracy and a menace to the freedom and safety of the seas, it has proved to be a weapon of frightful potency. In proof of this, consider the fact that this instrument of organized piracy and murder was responsible for the death of 12,000 seamen and 15,000 civilians in the British Merchant Marine. Add to this the casualties in the merchant marine of the Allies and neutral nations, and the total number of those who were made to "walk the plank," may well run up to 50,000.

The submarine was designed as a warship for the attack of other vessels of war, and as such, it has proved to be so complete a failure, that it is now admitted that any sum expended upon these vessels would return a much greater military value if it were put into an equal displacement of destroyers, cruisers, or other vessels.

We must not be misled by such successes against warships as were gained, early in the war, when the three cruisers "Cressy," "Aboukir" and "Hague" were sunk by a single submarine. The three ships were cruising at low speed, unattended by destroyers, and two of them were sunk while they were standing by rescuing the crews of the first torpedoed ship. When the limitations of the submarine came to be better understood, and with the development of anti-submarine devices and tactics, warships were proved to be practically immune to submarine attack. The high speed (constantly increasing) of the surface ship, which is denied to the subsurface craft, coupled with the rapid-fire gun and the depth bomb, have so greatly circumscribed the effectiveness of the submarine, that it has lost its once deadly menace.

Vice-Admiral Sims told a group of visiting American Editors in London that the Grand Fleet, surrounded by several lines of destroyers, was accustomed to cruise freely over the North Sea; and he went on to say that, if a fleet of submarines had thrown itself across its course, the Grand Fleet would have been able to "plough through" with no hurt to its capital ships.

The submarine has been called the weapon of the small nation. It is not even that; for the same authority testified before a senate naval committee that no massing of submarines off the coast could prevent a hostile fleet of battleships, properly attended by destroyers, from breaking through for bombardment and the landing of troops from transports.

But, for piracy upon the high seas the lurking, subsurface boat is the ideal craft; and hence, in view of the frightful reign of terrorism made possible by the existence of this weapon in the hands of an outlawed race, the question presents itself whether to safeguard the future freedom of the seas, the submarine should not be abolished by the forthcoming peace conference.

If there were any prospect that the speed of the submarine, *submerged*, could be raised to the point at which it could maneuver, *in a fleet engagement*, with battleships and cruisers whose speeds range from 20 to 35 knots, the case against the submarine would fall through; for in that event it would rise, as a tactical weapon, from a position of insignificance to one of commanding importance—in fact, it would dominate the whole naval situation. But at the present time, the naval critic has to admit that there is not the slightest prospect of thus increasing the submerged speed of the boats that, to be effective, must stay below the surface.

As a warship the submarine is a colossal failure—as a pirate ship it is a frightful menace.

Therefore, let Civilization put the thing under the ban. That can be done at once and for all time.

Would that we could as easily erase the foul blot which German officers and crews have left upon that fine reputation for honor and chivalry, which has distinguished the naval fighting men of every land for many a century past.

The Economics of Reconstruction

IN the world of business, when a plant or its product has become obsolete, one remedy is recognized in complete abandonment, writing off the invested capital as a total loss; but this drastic measure is seldom put into practice until other alternatives have been tried and found fruitless. Of such alternatives there are, on broad general principles, two.

The plant may be kept in operation, producing at a loss the thing it was designed to produce, until the tide turns or the owners are weary of sending good money after bad. Or it may, after more or less sweeping changes, go on with the manufacture of some other product that can be produced at a profit.

The nations of the earth find themselves, today, in the position of the owner of an obsolete plant, confronted with the necessity of deciding what to do with it. The war is over, and the world has spent, first and last, some two hundred billion dollars in its waging. Much of this has been truly spent, representing the value of the output that has actually been used up in fighting and in supporting the fighters. But an impressive proportion of the total has gone rather into construction of plants of one sort or another—factories, ships, cantonments, roads, railroads, harbors and what not. This portion represents what the accountant recognizes as invested capital, distinguished sharply from expense or costs.

The financial aspect is but one side of the matter. We have consumed a vast amount of labor in the fabrication of munitions and other products that have been used up; but aside from this, we have invested labor just as we have invested capital. We have invested the labor that has gone into the building of the plants just mentioned; we have invested the labor that has been diverted from old fields to new, to become the human capital of the industries receiving it; we have invested the labor values that have been created out of nothing.

All this is stamped investment of labor without thought of the money costs of the readjustments involved. Literally a certain proportion of our human capital has been given over to the building of new industries and new facilities, just as a corresponding proportion of our capital in gold and credits has been so given over. The human race is of definite numbers and capable of a definite effort; in the things that are created by its effort, the effort is either spent or invested, according to whether the immediate product is used up or remains subject to more or less permanent use. This is how the accountant distinguishes between investment and expense; this is how the accountant of human efforts must so distinguish. In the tangible and intangible equipment of our industries as rearranged by war's demands we have invested a formidable amount of labor, which is as much a consideration for the reconstructor as is the invested capital.

It is time for us to inquire in what direction our reconstruction program is to run. The same three courses open to the individual manufacturer are open to the nation. The alternative of unreservedly scrapping the money and the effort that have been invested in the industry of making war is too repugnant to be entertained for a moment. Our fighting units that are not needed in Germany must, to be sure, pass out of existence, as such, and return their members to civil life; and while much that the army has taught these men will be of future value to them, this value will not be sufficient to prevent demobilization from being a process of scrapping the money and the labor invested in the formation of our armies. But further than this the scrapping process must not go; it is self-evident that the cantonments, the railroads, the roads, the factories, the harbors, the ships, even certain branches of the army like the sanitary service, are not to be abandoned because the immediate need that gave them birth has been satisfied.

Of the other alternatives, that providing for transfer of the investment to another use than that for which it was made is by all odds the attractive one. The suggestion that we attempt to conserve our investment by continuing the manufacture of the tools and supplies of war-making is repulsive enough, when thus laid down in all its nakedness; but it is none the less necessary for us to be on guard against specious proposals that really amount to just that.

These proposals will ordinarily take the form of a plea on behalf of the laborer. Sometimes that plea will be made by labor itself, sometimes by demagogues seeking labor's favor. The argument will be that thousands of men are threatened with idleness and starvation if the manufacture of munitions is discontinued, and that therefore that manufacture should be kept up until the need for such provision no longer exists—which of course means indefinitely; no man is going to go out and get a new job when the Government guarantees that his present job shall last as long as he wants it.

Already we have seen this plea; already workers have protested and even struck against abolition of the overtime on war contracts that has made it possible for them to earn three weeks' wages in a week, or a week's pay in two days. It cannot be too emphatically urged that employment for employment's sake is a vicious principle. There is work enough for all at legitimate tasks of reconstruction; let those who have been making munitions return to other occupations, just as four or three or two years ago they shifted into their present field. The way to conserve the investment of capital and labor is not to squander it on production that cannot by any possibility be used. Such squandering would be bad enough at any time; and if the need for forced provision of jobs existed, the least that could be done would be to provide work of benefit to the community—building of roads, parks, harbors, public centers and public utilities of one sort or another, etc. At the present juncture, when useful—nay, essential—work exists for all and more than all, it is positively criminal to suggest that we go on wasting our productive capacity, our invested capital and our stock of human effort, in the making of things which we do not want, cannot use, and whose possession will actually constitute a liability.

The Battle of Jutland

SIMULTANEOUSLY with the surrender of the German fleet off the Firth of Forth, Scotland, Captain Persius, the well-known German critic made some astonishingly candid admissions regarding the decisive character of the defeat which was administered to the German High Seas Fleet by the British Grand Fleet in the Battle of Jutland.

It is characteristic of the wholesale deception practised upon the German nation by its rulers that the Kaiser should have announced the defeat at Jutland as a glorious victory for the German navy—a lie which was industriously distributed by German propagandists throughout the world, and notably in this country.

The first doubts as to the condition of the German fleet were aroused by the fact on the fleet's return to Kiel and Wilhelmshaven, the navy yards at these ports were tightly closed and no civilian was allowed to enter. This doubt increased as the months and the years went by and the German fleet made no second attempt to dispute the mastery of the seas.

The losses by actual sinking of ships of the German fleet are now proved to be just those which were positively claimed by Admiral Jellicoe in his report of the battle. But it will be remembered that he spoke of some three or four capital ships, which had come under heavy gunfire and were so badly listed or on fire, that their sinking before they could be brought back to port was considered to be inevitable. These vessels were very badly smashed up indeed; but, thanks to the most excellent subdivision and general under-water protection which is incorporated in the German ships, they evidently managed to limp back to a home port for repairs.

There used to be a saying among our naval officers, that the landing of the first successful heavy gun salvo would probably win the fight, meaning that if the ten or twelve big shells "straddled" the enemy ship, the destruction wrought would be so great, both upon personnel and upon the complicated structure and gear of the ship, that she would be heavily handicapped for the rest of the fight.

Now in his report, Admiral Jellicoe stated that his own flagship, the "Iron Duke," registered on a ship of the "Kaiser" class, and placed several successive straddles across her. Another of his ships, according to his report was able to hold the range long enough to straddle on another German ship with six successive salvos. Now the shooting was done with 1,400-pound, 13.5-inch high-explosive shells. The damage done must have been most serious, and Captain Persius now tells the world that "the losses of the German fleet were enormous, and that it was clear to every thinking man" on that day "that the Skagerrak battle must be the only general naval engagement of the war. His article in the Berlin *Tageblatt* goes on to say that "the German fleet was saved from destruction partly by good leadership and partly by favorable weather conditions. Had the weather been clear or Admiral von Scheer's leadership less able, the destruction of the whole German navy would have resulted. The long-range British gun, he says, would have completely smashed the lighter-armed German ships."

The honor of the fight lay with Admiral Beatty, who did not hesitate to bring his armored cruisers under the fire of the German battleships, in his determination to hold the enemy until the British battleship fleet could come up and get into action. This initiative, skill, and courage, in spite of the loss of three of his battle-cruisers gained for him the supreme command of the Grand Fleet and the honor of receiving, three years after the battle of Jutland, the surrender of the enemy against which he fought on that memorable day.

Electricity

Radio Instruments and Measurements.—With its customary skill and thoroughness the Bureau of Standards has recently published Circular No. 74 entitled "Radio Instruments and Measurements." This book, which contains 341 pages and numerous drawings and half-tone illustrations, covers the entire field of mathematics applied to radio apparatus. It is quite up-to-date, and there is little that a person interested in radio engineering cannot find in its numerous pages. Copies of this book can be obtained at the cost of 60 cents by addressing the Superintendent of Documents, Government Printing Office, Washington, D. C.

Electrification of Swedish Railways.—The Swedish railway committee was instructed by the King of Sweden at the close of 1915 to investigate the practicability of electrifying the railways of the kingdom. The potential water power of Sweden is immense, of which 4,000,000 turbine horse-power is now being developed. The great reduction in the supply of coal and the increase in the cost has accentuated the importance of developing Sweden's water power. This development has naturally been hampered during the war by the absence of metals necessary for the manufacture of turbines, dynamos, and other machinery and wires for power purposes.

Electricity and Ocean Salt.—Experiments in Norway with a view to extracting salt from ocean water by means of electricity have been successful and two salt factories will be started for this purpose in the near future. One is to be in western and the other in northern Norway, as these districts, on account of the fisheries, are the best home markets. Each factory is calculated to produce 50,000 tons of salt per year for a start, but they will be so built that the production can be brought up to double the quantity, if necessary. Besides the salt, different by-products will be made. The capital for the two factories is calculated at $5,360,000. Each of them will take about 6,500 horse-power for the normal production. During the war it has been impossible to salt down the fish. The new salt works should greatly improve the situation.

Nickel Plating by Rapid Process.—Rapid plating is the rule in America, according to our British contemporary, *Practical Engineer*. The common practice is to work at 10 to 20 amps. per square foot using concentrated solutions. But this has been improved upon. It was found that high grade commercial cobalt plating could be achieved in three minutes when working at 150 amps. per square foot and a solution of 312 grammes of anhydrous cobalt sulfate per liter. The same practice was then applied to nickel plating, but it was found that the nickel anode was apt to become passive, resulting in the generation of acid, which cut down efficiency and produced hydrogen at the cathode. This difficulty has been overcome by adding a small quantity of chloride and heating the solution. This done, a 25-gallon nickel cast can be worked at 125 to 150 amps. per square foot, producing heavy durable deposit in five minutes.

Purifying Gases Electrically.—An interesting summary of various processes for removing suspended particles from gases by electricity is given in the French *Revue Generale de l'Electricité*. A method recently developed in France by Messrs. Lailler and Gallot makes use of a series of tubes, the increased potential drop at the end of which is counteracted by varying the diameter. The efficiency of precipitation is stated to be directly proportional to the length of the tube and inversely proportional to the speed of the flow of gas. In the apparatus described two different methods are used. In one case a vertical tube with a fine wire down its axis is used; in the other case the dust-laden gas is introduced into a horizontal tube with a negatively charged wire stretched down its center. This has the advantage that the deposited material falls into hoppers in the lower wall of the tube and does not accumulate round either of the electrodes or the insulators to which the wire is attached and which are located outside the tube.

New Form of Electrical Cooker.—The London *Electrician* describes a form of electrical cooker which is designed on lines somewhat different from those usually followed, and which is now being employed in Germany. In most electrical cooking implements heating is effected by passing the current through metal wire or strip resistances. In this case, it appears, no such metallic heater is necessary, the water used to cook the food itself being the conductor. Two carbon electrodes pass through the base of a porcelain dish, which contains the water. The passage of the current through the water raises it to boiling point, arrangements being made to facilitate the condensation of the steam which then drips back into a trough. When all the water has been evaporated and has collected in the trough, the current is automatically interrupted, and it is stated that the length of time during which food is to be cooked can be determined by varying the quantity of water initially introduced into the vessel. There is nothing new in this device. As a matter of fact a similar form of electrolysis cooker was introduced in the United States but did not prove commercially successful.

Science

Forestry Research in Tasmania.—The Tasmanian State Committee of Science and Industry, though it has undertaken a variety of other investigations, has decided for the present to specialize in researches relating to forestry, with a view to a better utilization of the extensive forest areas of the country. Research in specified directions will be supported by grants-in-aid. The program thus far outlined includes, *inter alia*, studies on the production of potash from the ash obtained by the burning of leaves and twigs, and on the production of building materials from sawdust and wood after breaking down into pulp.

Gorse Seed Germinates After 25 Years.—Stories concerning the length of vitality of seeds are commonly fabulous—as in the case of the alleged "mummy" wheat. A case is, however, reported in *Nature* in which the seed of gorse (*Ulex europæus*) unquestionably germinated after lying dormant for 25 years. A 40-acre tract of gorse- and heather-covered land in Cumberland was drained, cleaned and plowed out in 1893. After having been kept in arable rotation for several years it was converted into pasture, whereupon numerous gorse seedlings appeared. These were carefully stubbed out, and the pasture remained free from gorse until last winter, when it was plowed up and sown with oats. The crop has now been reaped, and gorse seedlings are found all over the field. Evidently the last plowing has brought to the surface and called to life the seeds which had lain buried for a quarter of a century.

An Interesting Dustfall.—A study has been made by Messrs. A. N. Winchell and E. R. Miller, of the University of Wisconsin, of a shower of dust which discolored falling snow at Madison and elsewhere on March 9th, 1918. According to somewhat scanty reports, this colored snow fell at least from Dubuque, Iowa, to Chelsea, Vt., in an east-west direction, and from Madison, Wis., to Newberry, Mich., in a north-south direction. It covered an area of at least 100,000 square miles and probably much more. The total quantity of dust is estimated to have been at least a million tons, and may have greatly exceeded this, perhaps even amounting to hundreds of millions of tons. A study of the character of the dust and of the attendant meteorological conditions leads to the belief that the dust was blown all the way from arid regions in the far southwestern United States, and was therefore transported a thousand miles or more.

Tetraphosphate.—Under this name, shortened for commercial purposes to "tetra," a new fertilizer is now being manufactured on a large scale in Italy and elsewhere. According to a publication of the Canadian Department of Trade and Commerce, it is made by roasting natural phosphate rock powder for several hours in a specially constructed furnace at a temperature of 600 to 800 degrees C., together with about six per cent of a powder containing equal parts of calcium, sodium and magnesium carbonate and a little sodium sulphate. After leaving the furnace the product is hydrated by cold phosphoric acid, and for practical use is mixed with sand or dry earth until the necessary strength is obtained. "Tetra" was invented by Professor Stoppani, of Bologna, in 1914, and there are now 11 plants engaged in its manufacture in Italy, besides one in Egypt. A special commission appointed by the Italian Ministry of Agriculture reports that for wheat, rice, potatoes, oats, beans and clover the new fertilizer is much cheaper and equal if not superior to "super."

Place Names on African Maps.—Mr. Arthur Hinks, secretary of the Royal Geographical Society, has recently presented in the *Geographical Journal* an account of the work of preparing a general map of Africa on a scale of 1/2,000,000, on which the society has been engaged for the past 18 months. Three sheets have been completed and about a dozen more are in a forward condition. Nothing is more interesting in this connection than the manifold difficulties experienced by the compilers in the selection of place-names. The problem of spelling is bad enough, since account has to be taken of so many languages, native and European, and various schemes of transliteration. Troubles of this character seem, however, to be eclipsed by those arising from changes that have occurred in both names and places. Existing maps, says Mr. Hinks, are full of names derived from the journeys of travelers that are no longer recognized by those best acquainted with the country. Apparently many of them should never have appeared on permanent maps. Thus Tumepona means "We are saved," and was the name given to a camp where water was found in the nick of time by a certain traveler. As illustrating the mutability of the places themselves, it is stated that Marsabit, in British East Africa, which gives its name to a sheet of the Internation Map (1/1,000,000), though once an important administrative post, is now completely deserted. "The changes in native names are infinite, and it is probably near the mark to say that half the native names upon maps no longer represent any center of native population, and are no longer locally recognized in the country."

Aeronautics

Substitute for Goggle Glass.—It is understood that the Medical Research Board of the Division of Military Aeronautics has found a substitute for glass for aviators' goggles. The substance, which is not glass, has been on the market for some time, although it has not hitherto been possible to cast it in the right strength and thickness for goggles. The substance is described as hard and non-inflammable, and is said to ensure practically a non-shattering lens.

From the Enemy's Own Mouth!—Not the least interesting of the captures during the recent fighting has been an order signed by Ludendorff himself, which says: "No one is to open fire upon an airplane without personally making sure that there is no iron cross marking on the machine, or that the distinctive enemy markings are visible. It is very improbable, and has never yet been proved, that the enemy makes use of our national markings in order to deceive us. Fire should therefore never be opened once the iron cross is seen. This rule must be strictly observed." It will be recalled that the Germans have persistently tried officially to discredit the Allies by saying that they were using German markings on their machines, and now they have been forced to testify as to Allied honesty, apparently because their own men have been bringing down German airplanes.

A New Italian Observation Balloon.—The chiefs of the aerostatic section of the Italian army, Major Avoria and Signor Prassove, Director of the Italian Army Aircraft Works, have produced a new type of observation balloon providing much more satisfactory results than the Parseval-Sigsfeld kite balloon or the trilobal Caequot balloon, according to *L'Aeronauta*. The new type is essentially a spherical aerostat fitted with what are equivalent to stabilizing fins, and acting as a kite. It may be employed in winds of over 55 miles an hour, whereas the Parseval-Sigsfeld type could not be safely used in winds exceeding 12 miles an hour. The new type requires a smaller gas volume for equal load and owing to its smaller dimensions is easily transported and housed, while in flight it represents a smaller target to aircraft fire. A further advantage in the employment of mooring cables of small section follows from its smaller head resistance, while, should the mooring cable snap, the observation balloon may be operated as a free balloon.

Caproni's Proposed 18,000-Horse-power Air Cruiser.—It was announced on November 11th, at the annual meeting of the Aero Club of America, that Mr. Gianni Caproni, the famous Italian airplane constructor, is planning to construct an air cruiser of the heavier-than-air type with a number of motors aggregating 13,000 horse-power. The armistice having lifted the ban on the discussion of coming aeronautic developments, the Transatlantic Flight Committee of the Aero Club of America, of which Mr. Henry A. Wise Wood is chairman, made known the fact that there are several airplanes already being designed, each to be equipped with 5,000 horse-power. Caproni has one such machine, and it was in connection with the discussion of this type that it became known that Caproni has an 18,000-horse-power air cruiser under consideration, which will be capable of carrying a large number of passengers in non-stop flights across the Atlantic. The famous British constructor, Handley-Page, is also planning to manufacture a 5,000-horse-power machine, and similar plans are under consideration in the United States.

War Feats of the Airplane.—We have become so used to stories of wonderful feats accomplished by aircraft during the war that everything we hear nowadays leaves us almost cold. The things that, before the war, would have furnished bold headlines in the newspapers and have been a topic of discussion for days in the places where people congregate excite no more than passing notice. It is scarcely surprising, then, that the story of how touch has been maintained for more than two years between the Allied armies of the Near East and the gallant remnants of the Serbians and Montenegrins who were hidden among their mountain fastnesses and of how they were supplied with arms and cartridges by airplane, has hardly attracted attention. There has been nothing but the barest mention of the fact. We are not told how and from where the machines carried out their mission, of how many were engaged in the task of supply, or of what effect their wonderful performances may have had on the situation by keeping up the spirits of the gallant few who have held out against the enemy for so many weary months. We are simply told that the Serbian army, in its victorious advance, has obtained touch with these bands, who "since the Austro-Bulgarian occupation have been holding out among the mountains and have been continuously supplied with arms, food and cartridges by airplane." Now that the episode is historical, concludes *Flight*, and the enemy can gain no possible advantage from knowing how it was done, it is a pity that some official commentator with an imagination cannot tell us the full story, which must be a real epic of war.

The Saving Grace of War

Some of the Vicious Industrial Habits Which We Are Abandoning Under the Pressure of Military Necessity

By John Walker Harrington

BLACK stumps where late proud forests grew; streams oozing putrid through once fair and sunlit fields; the air oft tainted by gases which poison and slay—this is what war is in the embattled lands beyond the seas. But in America it checks the defilement of streams by unsightly sludge and scum; it halts the dumping of refuse on the earth; it pens and uses the noxious vapors which not long since were turned loose to stifle man and beast and to blight the garden and the farm.

Before the war, everybody knew that trade had no right to cast away its slime and sludge and stench. The manufacturer knew it better than the rest of us, but he pleaded that the cost of saving his unwelcome wastes equalled, if it did not exceed, the prices which he could get for them. Then came the great increases in the costs of raw materials, making it possible to wring wealth from filth and to pay for expensive recovery apparatus out of the salvage of a single year. Once the factory and mill owners are set on the way toward keeping the refuse which formerly they spurned, the endless chain of the by-products begins to unwind. Already the plaint that, when there are no more war prices, the saving of noxious wastes will no longer pay is almost silenced; groups of new substances are being found which in days of peace bid fair to meet all the costs of manipulation.

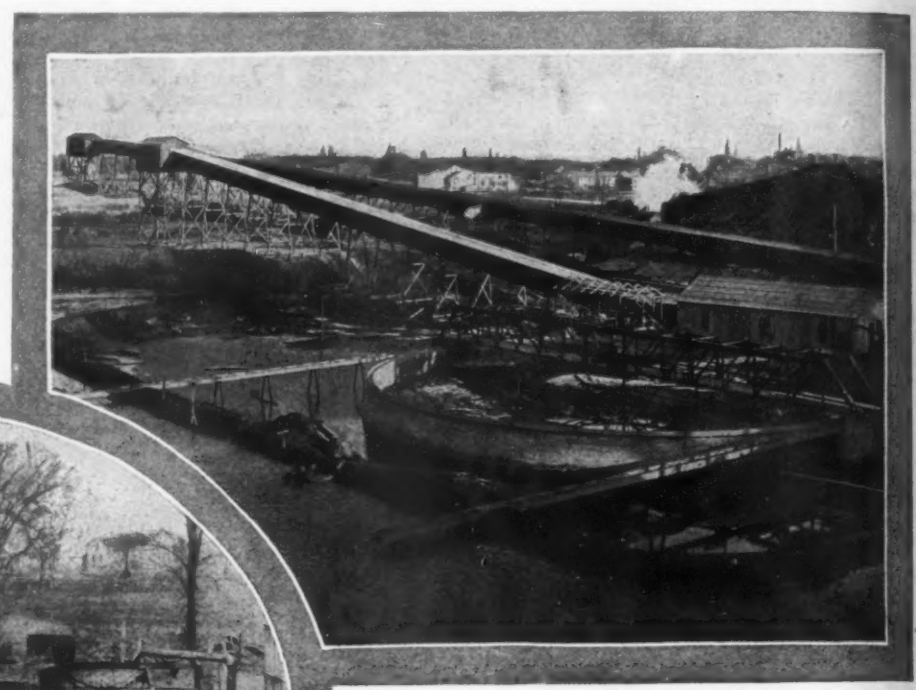
Thanks to the conditions brought about by the shortage of materials, much has already been done to make this a cleaner and a sweeter land. We should be able to breathe more freely, for the time was at hand when we would have been wearing gas masks on Riverside Drive and smoke protectors in Pittsburgh. We shall be able to go fishing in our rivers, to sail our bays in comfort, to rejoice in flowers no longer strewn of a morning with acrid, chemical dust. This is a state of affairs which will come home to every man, woman and child, for it means houses which fumes will not ravish of their paint and rob of their selling value; it means cities, fit places in which to dwell; it means better and cheaper food; last but not least, and quite as a social by-product, it makes for unsullied nature and the keener enjoyment of life itself. If then any man or corporation insists that he must deprive the community of its birthrights of air and land and stream, let him be led up to the counter of Mars & Co., forthwith and learn that pests may be changed to profits and that he can grow rich by giving his fellow beings a chance to live in health and peace.

Perhaps the reader has never heard of a garbage barrage. Out of every ton of household waste in our large cities can be got enough glycerine to load 14 shells for the French 75-millimeter guns. The glycerine, duly nitrated, becomes the nitroglycerine of war. It is taken in large quantities from the garbage of the city dumps, which may yield from three to five per cent of fat according to the season. Garbage grease in ante-bellum days brought only about 3¼ cents a pound and barely paid for the cost of rendering. It brings at least 15 cents now and often goes to 20. Its recovery, despite the fact that there has been complaint about the odors from the New York plant, can be conducted without unpleasant smells.

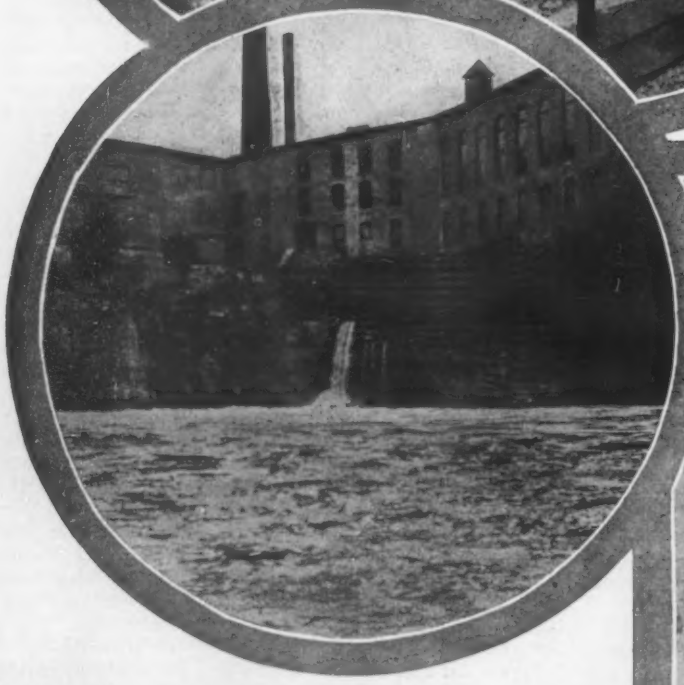
The story of garbage is no epic. It is a plain tale of offal turned to account; and yet every housewife and every landlord should know how much good can come from properly attending to these wastes. They contain elements from which powerful chemicals can be drawn, for in them may be found toluol and an endless variety of valuable derivatives. And why dump tin cans into back lots to mar the outlook, when if detinned, they furnish fuses, and later shrapnel?

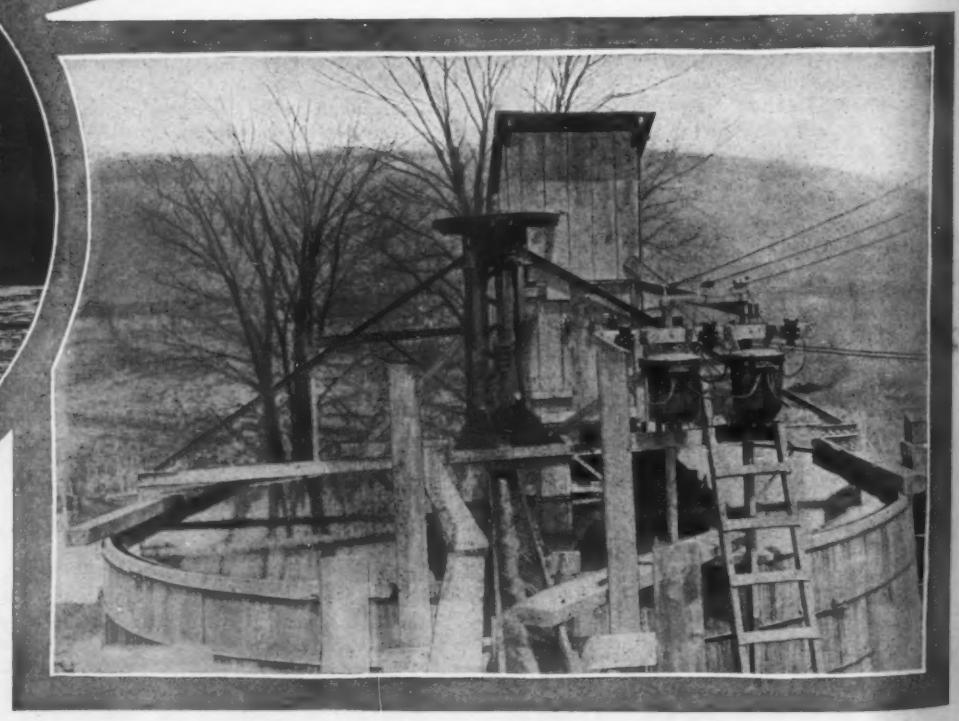
From the industrial plants in the district of Pittsburg alone, 6,500 tons of free acids are discharged every day into such important rivers as the Monongahela, Allegheny and Ohio. These chemicals not only eat into

(Continued on page 464)



The Dorr thickener for treating waste waters from tanneries. The material held in suspension is precipitated to the bottom of a tank. Here it is agitated by plow blades attached to radial arms that are carried on the lower end of the central vertical shaft shown in the cut below. Through the rotation of these blades, which are set at an angle, the settled material is moved to a discharge opening at the center of the tank. By this continuous removal of the settled material, the formation of gases in the sedimentation basin is prevented. Above, a general view of the apparatus, including the troughs that deliver the water to the thickener; at left, the open-air beds where the sludge from the machine is filtered and dried; below, a close view of the precipitating tank, showing the agitating and discharging mechanism.





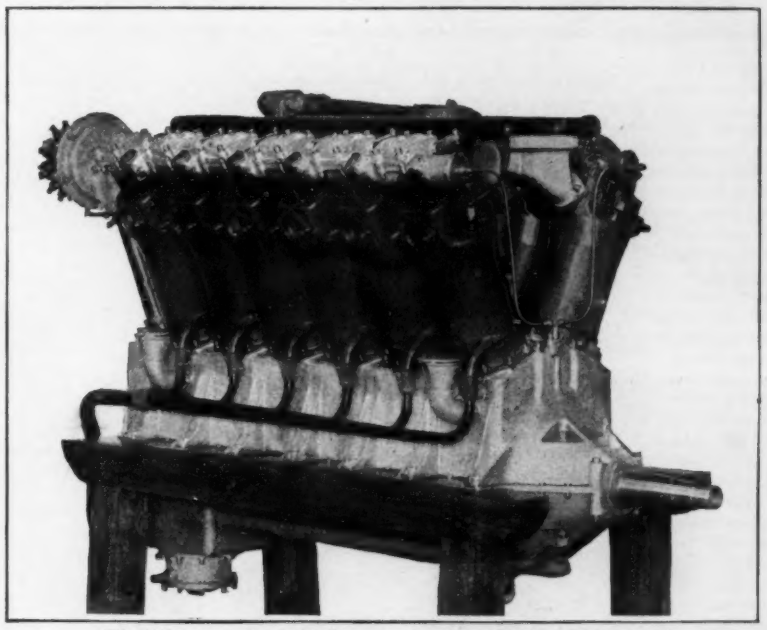
The Androscoggin River directly below a mill-race at Berlin, N. H., showing the volume of sulphite waste formerly allowed to flow away unutilized from a single paper mill. This liquid, a nuisance to the paper-makers, is now found to be a valuable source of explosive bases, and yields in addition grain alcohol, leather and rubber fillers, and a binder for fuel briquettes.

The Liberty Motor

Its Checkered Career and Details of Its Construction

AT last the restrictions of the Censor have been lifted and we are able, without in any way giving aid or comfort to the enemy, to disclose to our readers pictures and drawings of that engine of mystery, the Liberty motor.

The career of this motor has been a checkered one. Announced first as a five-day creation, a masterpiece of ingenuity which could be turned out immediately in tens of thousands by typically American quantity production methods, it was loudly acclaimed as one of the greatest inventions of the war that would give America the mastery of the air. Then the pendulum swung to the opposite extreme. In the sharp reaction from this grossly exaggerated opinion of the Liberty motor, the machine was pronounced a pitiful failure, an immensely heavy brute with a voracious appetite for fuel, a mere automobile engine, absolutely unfitted to take on wings and soar among the clouds. It was now held up as a glaring example of inefficiency and incompetency. Ugly stories of graft were whispered about—of hundreds of millions of dollars absolutely thrown away. However, by the time the pendulum had reached that extreme the Liberty motor had passed through the long and tedious period of experimentation and preparation for quantity manufacture and it had undergone a thousand and one changes in minute details, all of which consumed a great deal of time, and when the public criticism had reached its highest tide this engine was already being turned out by at least one of the large manufacturing concerns in fairly large quantities and the daily production was steadily increasing.

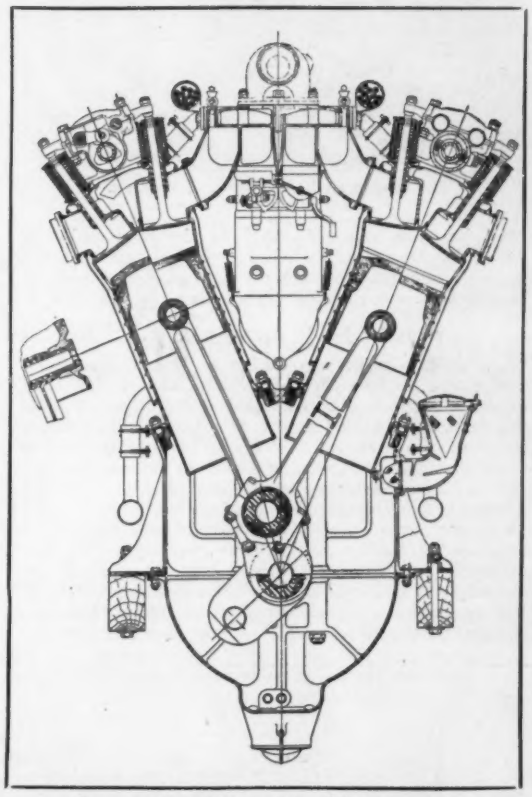


The Liberty motor—450 horse-power in a weight of 825 pounds

It was on Thanksgiving Day, a year ago, that the first Liberty motor, built on an organized producton basis, was wrapped in an American flag and shipped from the Packard plant to the aircraft forces. It was not until the following March that the Packard Company had organized its factory, produced the necessary tools and jigs, and completed the preparation for the production of the motor in quantity. This was the first large plant to undertake the manufacture of the Liberty motor. Five other plants began operations later and it was not until well along in the summer that production was proceeding at full capacity.

On the 21st of November, the Packard plant shipped its five thousandth Liberty motor, and there is every prospect that its entire order for 6,000 motors will be completed well before Christmas Day. The Lincoln Motor Company also has a contract for 6,000 motors; while the Ford Motor Company's contract calls for the construction of 5,000; the Nordyke & Marmon Company for 3,000, the General Motors Corporation for 2,000, and the Trego Motor Company for 500, a total of 22,500 Liberty motors. Despite all criticism of delay and inefficiency, our country had 15,000 Liberty engines when the armistice was signed, all of which had been produced within eight months.

In the Senate report on the aircraft situation, as well as in the report of the Hughes investigation, it was declared that the Liberty motor had proved a decided success. To be sure, this motor is not adapted to all types of airplanes. Somehow, the public gained the notion that the Liberty motor would serve every purpose as an airplane power plant. As we pointed out very clearly many months ago, the Liberty motor, although one of the lightest, if not the lightest motor per horse-power, is entirely too heavy a machine for a light battleplane. It will be clearly evident to anyone who stops to consider that power is not the only requisite in an airplane, and a machine which carries an engine weighing over 800 pounds cannot possibly make the quick turns that are accomplished by a machine equipped with a 200- to 300-pound engine. The momentum of the engine will carry it forward despite the action of the airplane's rudder, and it takes time to swing it from one direction to another. The Liberty motor therefore, was never intended to be put in a small airplane with a single operator who aims his gun by steering his machine toward his target, but it is adapted for the larger machines which are used for bombing purposes, for observation, for reconnaissance, and also for the larger battleplanes, in which there is a machine gun operator, as well as a pilot.



Cross-sectional view of the Liberty motor

As we have stated in previous issues of the SCIENTIFIC AMERICAN, the Liberty motor weighs about 825 pounds. Its horse-power was raised during the development period from 367 to 450, and in some tests it has run up as high as 480.

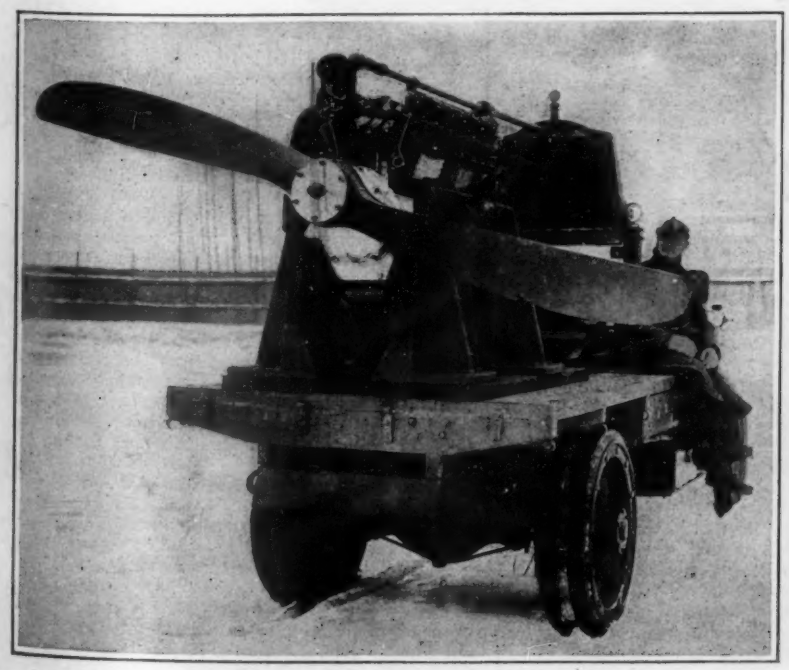
In our story of the Liberty motor published in the issue of June 1st last, we showed that this engine was not designed in five days and that it was not a radically new invention. It was the result of a year and a half of experiment on the part of the Packard Company prior to the war, and in the famous five-day conference it was this engine which was modified to meet requirements of the Government and then built very hastily within a month so that it could be delivered in Washington on Independence Day as the "Liberty" motor.

The original Liberty motor was fitted with eight cylinders, but this design was not accepted because word came from France that a motor of much higher power was needed, consequently the 12-cylinder type was decided upon. One of our photographs shows an eight-cylinder Liberty motor being tested out at the summit of Pike's Peak, in order to determine its operation under the rarified atmospheric conditions prevailing at that elevated spot. The motor was also tested out at sea level.

The first 12-cylinder Liberty motor was tested by mounting it on a large truck, as shown in one of our photographs, and driving the truck by means of an airplane propeller. This truck was propelled at speeds of over 40 miles per hour through the snow by means of this form of drive. On one occasion the brakes were set to lock the wheels, and yet the truck was moved bodily forward, with its wheels sliding along the ground, by the powerful thrust of the propeller. In our illustration it will be noticed that there is a nick in one of the blades of the propeller. This was produced by a bolt which was accidently jarred off the truck and fell against the propeller blade. Because of the enormous speed of the propeller, this light piece of metal caused it to tear out a large piece of wood.

Coming down to the more minute details of the Liberty motor, we may refer to the line drawing representing a sectional view of the machine. It will be noticed that the engine is of the V-type, with cylinders disposed at an angle of 45 degrees to each other. In other airplane motors the angle is usually 60 degrees, but this sharper angle was adopted to reduce head resistance and also to

(Continued on page 466)



Propelling a motor truck with a Liberty motor

Testing the 8-cylinder Liberty motor at Pike's Peak

World Markets for American Manufactures

Edited by LYNN W. MEEKINS

A department devoted to the extension of American trade in foreign lands

The High Tide of Chilean Trade

THE total trade of Chile last year was the largest in its history, exceeding by more than $120,000,000 its previous high record. For several years the United States has sold more to Chile and bought more from that country than any other nation. The most remarkable gain in our sales in 1917 was in motor cars. Although the roads of Chile are not the smoothest in the world, and the streets of some of its cities offer pretty rough going for vehicles, the United States exported 2,587 passenger cars and 69 motor trucks to that South American republic as compared with 826 and 17, respectively, the year before. In Santiago, the capital, which has modern paving and wide avenues extending through the city, automobiles are popular. A peculiarity of the Chilean trade is that a chauffeur is always required, as it would never do for the owner to change a tire or to crank a machine himself, and a car is usually left with a chauffeur to avoid the possibility of having some part of it stolen or the machine injured.

Of the 2,603 miles of coast line of Chile, more than 2,000 miles are covered by the longitudinal railroad, making about four-fifths of the republic accessible by rail. As its highways are improved, Chile will offer an increasing opportunity to manufacturers of motor trucks, which are needed for transporting nitrates, ores, and other products of the country. Primitive bullock carts have been used for centuries for all sorts of hauling. Experiments have shown that trucks do this work 40 per cent cheaper. The street railway systems of Chilean cities have bought more than $300,000 worth of electric cars from the United States during the past two years. The Chilean railroads in 1917 alone purchased over $500,000 worth of American freight and passenger cars.

Although the manufacture of cement has been begun in Chile, the local factories cannot produce enough to supply the demand, and imported cement easily finds a market at a slightly higher price than the domestic product. Imports from the United States in 1917 were valued at $112,393, an increase of about 20 per cent over 1916. According to the agent of an American firm in Santiago, American cement deserves high praise on the honor roll of good export packing. During a tour of the west coast of South America, hundreds of barrels of various brands of American cement were seen, and with a few exceptions they were in excellent condition when they arrived. These barrels had a strip of board across each head, which prevented them from being broken in, thus saving them from the fate of a shipment from Europe not similarly protected.

"Besides the increase in trade since the war, many other indications seem to point to a high admiration on the part of Chileans for all things American," writes a business man from Santiago. "In some lines this has been very marked. It would be exceptional to pick up a newspaper these days and not find articles dealing in a favorable way with the United States. Out of five pages of reading matter, one of yesterday's papers devoted one entire page to American affairs, in addition to numerous cablegrams dated from New York and Washington. The magazines and illustrated weeklies also show the North American influence, many of their pictures and covers being reproduced from our periodicals."

Chile's friendship is worth cultivating for several reasons. First—that country offers valuable raw materials that we need; second—the development of the country's great natural resources calls for the importation of a large quantity of fuel, lumber, and railroad materials; and third—the Chilean market, although comparatively small, is very diversified and many lines of goods can be sold there. The climate makes the people more energetic than those of some other South American republics.

The widespread distribution of American products in Chile has been due chiefly to the large importing and exporting firms in that country with offices and credits abroad, and branch houses in the more important Chilean cities. They carry to Chile all kinds of American goods, either for stock or on order, and bring Chilean products to the United States. They buy here on advantageous terms and deliver the merchandise in Chile according to market requirements as to credit. The smaller importing wholesale and retail houses avail themselves of four sources of supply—the larger importing house, the resident foreign purchasing agent, the traveling salesman, and the resident agent. A great proportion of the import trade of Chile, and in general of all South America, has been done by resident commission agents representing principally European houses. As far as can be learned, there has been no increase in the number of traveling salesmen in Chile handling American goods since the outbreak of the war.

Chile has turned to the United States as the one great open market for purchases, but the increased buying has been done principally through the established lines of trade by the houses which already had connections in the United States. One American manufacturer believes that the logical method to develop permanent business in Chile is to follow the successful example set by British and German merchants—to invest a reasonable amount of money in the marketing of merchandise in Chile on the trade terms current there, instead of endeavoring to sell goods at the port of shipment on the trade terms current in the country of origin.

The direct line of fast passenger steamships beween New York and Valparaiso, started about a year ago, but since suspended because the vessels were taken over by the United States Government, provided the most efficient means of communication between the two cities that has ever prevailed. This will probably be resumed in the near future. The parcel post convention between the United States and Chile, which expired in December, 1917, has been renewed, much to the gratification of American shippers. With improved facilities for sending our products to Chile, we have a good chance to hold first place in that country's trade.

The ox-drawn beer-wagon of Valdivia

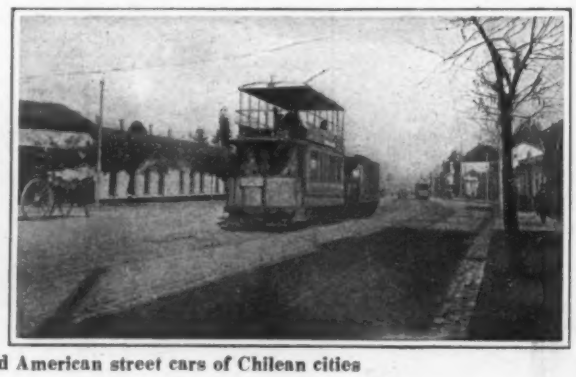
Vision in Advertising

"SEVERAL years ago during a visit to England I stayed longer than expected and found that I needed a new pair of shoes," said one of the members of the foreign sales department of a large manufacturing company the other day. "I was in a comparatively small city and didn't see any American shoes on display. Not knowing anything about English makes, I had decided to defer my purchase until my arrival on London. The night before leaving for the metropolis, I happened to attend a motion picture show, or cinema, as they call it in England. Short reels were shown, one advertising the products of a boot and shoe manufacturer. It began with a sort of puzzle picture in which the letters of his name were made to appear in irregular order, but each letter after more or less confusion finally arranged itself in place. This was followed by a display of shoes which were made to walk out upon the screen, line up in military style, and parade around the picture in march time. Then came a scene in which a customer entered one of the retail stores operated by the manufacturer. The shoe boxes came forth from their place on the shelves and mysteriously opened. The shoes came out and placed themselves upon the customer's foot one after another until he showed by his happy smile that he was satisfied. No clerks were in attendance. The motto was 'Blank's shoes sell themselves.' That film sold me a pair. The other commercial reel was a short play in which the attention was temporarily centered upon a pretty girl, but the mask was so cleverly withdrawn that the audience seemed rather pleased after all to know that the purpose was to advertise an automobile.

"This experience served to convince me of the value of the motion picture screen as an advertising medium. I had seen slides used for advertising purposes but they were generally rather crude and didn't leave a lasting impression. The industrial motion pictures that had come to my notice were entirely too heavy, seeming to absorb too much of the mechanical features of the manufacturing process and lacking completely the necessary human interest to make them effective.

"After becoming manager of our export department, one of the first things I had to pass upon was our future advertising policy. First of all I tried to put myself in the place of—well, say a man in Peru who had never heard of American clothing. The average Peruvian outside of one or two principal cities is not an inveterate reader of newspapers. A majority of the population of Peru consists of Indians who can't read. Well, then, if I couldn't read, how could I learn anything about American goods except by word of mouth or by seeing the articles themselves? After seeing a film showing every step in the evolution of clothing from the raw material to the finished product and bringing out the high degree of specialization and sanitary working conditions in some of the largest plants in the United States, I shouldn't soon foregt it. And after the manufacturer's trade-mark was shown at the top or the bottom or in the corner of every picture, I should know what to ask for when I went shopping on pay day.

"All the world is keen for the movies, and the audience at a picture theater is fair game for the American advertiser. But he shouldn't take advantage of it. The people are there to be entertained, and the pictures showing his goods should be as full of life and originality as possible. The title and the sub-titles are important. They should, of course, be in the language of the country where the film is to be shown, and they should be snappy. If the caption is cut and dried, very few of the audience will take the trouble to read it. A well-constructed reel, showing how an article is made and the purpose for which it may be used, is an advertising weapon that American exporters should employ more frequently in foreign markets."



The plank pavements and American street cars of Chilean cities

The Philippines as a Trade Base

OUR fellow-Americans, the Filipinos, are going to be valuable lieutenants in our Far Eastern trade drive after the war. The extent to which American manufacturers take advantage of the raw materials and the cheap and skilled labor available in the Philippine Islands and establish branch factories there will have an important bearing upon the volume of sales of American goods in the Orient, according to a business man of Manila who is well posted on the commercial outlook in that part of the world. With rich iron deposits and coal equal to the best on Puget Sound, both widely distributed throughout the islands, and copper in the northern highlands of the archipelago, the exploitation of these resources will meet many industrial needs

"The Philippines are among the most progressive countries in the Orient and the question of skilled labor can be easily solved," says our Manila informant. "Those American manufactured products which would not stand Japanese competition might as well be made by American plants built in the Philippines. With labor as cheap as in Japan and raw materials accessable, the wisdom of erecting branch factories in our islands is self-evident. We would then be in a position to enjoy a reasonable share of Far Eastern trade."

Japan, our principal rival in the Orient, is now a humming industrial hive. It has just donned its commercial long trousers and its foreign trade grows apace. Some years ago its principal export service was to supply artistic novelties; now it is manufacturing and exporting many practical necessities. Through skillful organisation, low prices made possible by cheap labor, and good distribution by means of many vessels available for ordinary commerce. Japan has entered far distant markets in the past few years with the same remarkable success that it has achieved nearer home. The chief criticism of Japanese goods has been connected with their quality, which has been declared inferior in some cases to that of products exported from other countries. This has induced the Japanese Government to open examining offices which prohibit the export of hemp braids not up to the standard and determine the grades of export matches and the markets to which each grade should be sent.

"Lying at the front gate of Asia, the Japanese will naturally use this advantage," remarks the Philippine merchant. "Add to this the cheapness of their labor and their rapidly growing number of skilled workmen and it is apparent that the United States cannot compete with them in many lines which they manufacture. This weakness in our commercial position in the Orient may be developed into an invulnerable strength. The Philippines offer the key to our problems."

Wireless Telegraphy and Static

How the Conquest of This Phenomenon Would Greatly Aid Radio Communication

By An Old Radio Operator

ONCE more the claim is made that "static"—that bugbear of all wireless men—has been conquered. This time it is in the form of the recent announcement of the Marconi Wireless Telegraph Company of America, which gives full credit for the achievement to the well-known radio engineer, Mr. Roy A. Weagant, who heads the engineering staff of that organization.

By static the wireless man means that form of atmospheric electricity which interferes with the operation of a wireless station. Static is most troublesome during summer months, generally during the hours from noon onward, and particularly from sunset to sunrise. In certain installations the static disturbance appears to be due to the periodic charging and discharging of the aerial system; that is to say, atmospheric electricity is induced and stored in the elevated wires forming the aerial until such time as the potential of the accumulated charge is sufficient to break down the barriers and a current flows through the apparatus and to the earth connection.

Near the waterfront it is often noticeable that static conditions are most severe. The writer has in mind a former U. S. Army wireless station in New York Bay, where it was almost always possible to accumulate quite a static charge in the aerial. When the aerial was disconnected from the ground and from all apparatus, the static charge accumulated until it broke down spark gaps measuring two and even three inches across. When it is remembered that it takes roughly 20,000 volts to spark across a one-inch gap between needle points, the potential of the accumulated charge is soon obvious.

But the usual form of static is far milder than that just mentioned. Instead of accumulating in the aerial system, it flows steadily through the aerial and the apparatus to the ground, making its passage known by affecting the receiving apparatus and thus interfering with the reception of signals. Such static is due to electrical discharges between clouds and between clouds and the earth. Even with a blue sky overhead, such disturbances often prove most troublesome, in which case they are most likely due to a distant thunderstorm. Lightning discharges can be detected at considerable distances by any wireless receiving set, and such static disturbances generally prevent the handling of wireless traffic long before the storm clouds come over the horizon.

Static disturbances in the early days of radio communication, when the coherer and Morse register were employed for recording the signals in the form of dots and dashes on a paper ribbon, took the form of a jumbled lot of dots and dashes. Often these nondescript dots and dashes persisted for hours and even days; for it was next to impossible to eliminate the static and still receive the signals because of the comparatively insensitive detectors and weak transmitters of those days. Furthermore, there was no way of differentiating between the static rumble and the signals, as is possible to some extent with the audible receiving systems of today.

With the introduction of the telephone receivers and the audible method of reception, static took the form of strange sounds. Generally, static sounds like hailstones beating against a sheet of tin. Again, it may sound like short hisses from a steam pipe, or periodic discharges of coal down a chute. The tone of static is generally very low, while that of wireless signals is generally higher, particularly at present.

Of the various means of mitigating static, perhaps the earliest was better means of tuning. By tuning is meant the bringing of the transmitter and receiver into sympathy or tune, so that the receiver responds to the signals of the selected transmitter to the more or less total elimination of other signals. Tuning has greatly aided in the combatting of static. From the simple circuits of the early wireless receivers, there have come those systems in which several circuits are arranged in series, all inductively coupled. That is to say, the current in the aerial circuit induces a secondary current in a second circuit; and this current, reacting on a third circuit, induces a third current which is brought to bear on the detecting device which in turn operates the telephone receivers worn by the operator. Such an arrangement permits of elaborate tuning, and the inductive coupling may be made either tight or loose; so that by a process of elimination one train of signals after another can be cast out until the desired one alone remains.

But the great thing to bear in mind with regard to elaborate tuning circuits is that there is a loss in transferring currents inductively from one circuit to the next. This, however, has been overcome by the powerful transmitters of today, which assure the transmission of a sufficiently powerful train of waves to withstand the "weeding out" process at the receiving end.

Elaborate tuning circuits have done much to master static, although static, being of a very wide wave length and therefore not susceptible to delicate tuning as are the transmitted waves, has often come through all tuning circuits along with the desired signals. Most of the systems in which the conquest of static has been claimed, have been based on intricate tuning systems which have sometimes worked and sometimes not.

Another method of handling static has been by means of the recent "beat" type of receiving sets. In these sets a local wave generator, usually of the vacuum valve design, can be adjusted to produce an undamped current of any desired frequency. This current is introduced in the same circuit as the received signals, so that by having a slight difference in frequency between the incoming signals and the locally generated waves, the two currents alternately help each other and oppose each other, producing "beats" or periodic signals. Such systems have proved comparatively effective in handling static, since they permit of a fine distinction between all signals received with a view to selecting just one of them. However, the "beat" receiver responds best to those signals known as undamped waves, as compared with the damped waves generally employed.

Still another method has been to employ a tuned reed in place of the usual telephone receiver at the receiving station. Thus the tuned reed responds only to a signal of the correct pitch, to the exclusion of all others. Static is generally pretty well eliminated by such harmonic forms of receivers—and so are all other signals for that matter, proving disadvantageous at times.

The skilled operator can generally read signals through static disturbances unless the static is too loud. With modern transmitters which emit high-pitched signals of whistle-like sound, the signals can be readily distinguished above the static din the greater part of the time. It is only in long-distance communication that static forms the greatest obstacle, and that accounts for the frequent and long shut-downs in some of the trans-oceanic wireless stations.

So it is evident from what has been said in the foregoing that there have been numerous ways of removing static under *certain* conditions. But what has been wanting all these years is a way that will eliminate static under *all* conditions. Perhaps Mr. Weagant has discovered some new and totally different way of handling received signals. If so, then there is much promise for the future of radio communication.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

The Doughboy's Laundry

To the Editor of the SCIENTIFIC AMERICAN:

On page 253 of your issue of September 28th appeared an article entitled, "A Mobile Laundry Built Like a Sectional Bookcase." You state in this article:

"This accomplishment goes to the credit of an Ohio firm which makes trailers and nothing else. Accordingly it is their business to be right up to the minute in trailer possibilities; and when a call came for portable laundries to be used on the American front in France, they promptly developed the outfit which we here illustrate."

In the next paragraph I find the following sentence:

"With the temporary canvas walls removed from the two inner sides of each section, and the four fitted together like the members of a sectional bookcase, a laundry is formed large enough to care for the garments of 8,000 men at a single washing."

Both of these statements are absolute inaccuracies. The only part of the mobile laundry unit which is made by the trailer company to which you refer is the trailer itself—the flat bed mounted on four trucks, the simplest portion of the entire unit. They have nothing to do and never had anything to do with the arrangement or building of the four walls or the fitting of the laundry. The method of joining up the trucks, putting the side walls on them and fitting them with laundry equipment was a thing entirely outside their part of the construction of these units.

The second statement that I call to your attention is even more preposterous. In a cantonment the size of Camp Sherman, where about 45,000 men are lodged, there are installed 24 washers, each about 50 per cent larger than those which are put on these portable units. To accommodate the work of the men in the camp, these 24 washers run continuously from Monday morning to Saturday night. So the statement that the two washers that are mounted on each mobile unit will, in a single run, do the washing for 8,000 men is obviously the statement of one who does not know what he is talking about.

As a matter of information, I want to point out to you the real facts in regard to these units. Early in 1915 a representative of the Russian government came to my company, stating that one of the great problems in the Russian army was that of keeping clean the men's clothing—that because of the filth in the trenches, all garments became caked with mud, and the bodies of their wearers became breeding places for vermin. The Russian government was very anxious to have worked out some plans for the cleansing and sterilizing of the men's clothing.

At that time we worked out three different propositions for them in an engineering way. The first contemplated the equipment of a complete railroad train, fitted to care for the clothing of an entire regiment at a time. The second involved the trailer scheme which you illustrate. and the third was for the mounting of the laundry equipment on single motor trucks.

When the United States got into difficulties with Mexico, we submitted these plans to General Wood, at that time Commander of the Department of the East, but no action was then taken. When occasion arose for means to keep clean the clothing of our soldiers in France, the matter came up again; and there have been a number of the units furnished to the American Expeditionary Forces. The original plans are in our possession, together with the original letters of acknowledgment from the various government departments. The concern to which you gave credit for the idea had nothing to do with its development until after our government decided to use, in France, units of the design in question.

My attention is also directed to an erroneous article appearing on page 359 of your issue for November 2d, "A Steam Laundry that Goes with Our Army." This apparatus is not a washing machine in any sense; it is not a laundering unit, as you describe it, it is purely and simply a sterilizer, and nothing else. I have no fault to find with your illustrations, which here, as in the other instance, represent the outfit in question correctly; but I do find fault with the inaccuracies in your text.

LEONARD S. SMITH.

Cincinnati, Ohio.

[It will be understood that the SCIENTIFIC AMERICAN is seldom in a position to investigate more closely information that comes to it from sources which have always been and therefore may fairly be presumed still to be, fully reliable. In both the cases of which our correspondent speaks, the detailed information, which he criticizes, was supplied by the contributor of the pictures, which he states were quite accurate. In each case the picture carried on its face such unmistakable evidence of its accuracy that we were not moved to question the accompanying statements. We regret that any inaccuracy or ambiguity should have on this account crept into his published accounts of these devices.—THE EDITOR.]

Thirty-Five Knot Mail Steamers

To the Editor of the SCIENTIFIC AMERICAN:

The British Navy has been increased during the war by 300 per cent, or from a little below two and one-half million tons to over eight million tons. They now have some super-dreadnaughts of 30,000 tons with a speed of 26 knots. Such war ships, however, are slow and small in comparison with the five United States battle-cruisers voted by Congress over two years ago. During which time our own great Navy has been more than doubled. This would seem to indicate that there is a redundancy of war ship tonnage, for the immediate future, if not for all time. If this be so, would it not be a safe and economic departure to adapt two or three of these great ships for conveying our mail across the Atlantic for a time? Side armor is not necessary for these ships, but extra deck armor, as shown by the SCIENTIFIC AMERICAN, should be fitted in connection with the electric transmission, and superstructures associated with an extended boat, and shelter deck, would probably be demanded. With their 35-knot speed, they could easily make the voyage from New York to Milford Haven within three and one-half days. This would more than make up for the loss of the "Lusitania" physically. It would also increase our prestige as the great maritime power of the future, and prove of great economic advantage.

JOSEPH R. OLDHAM.

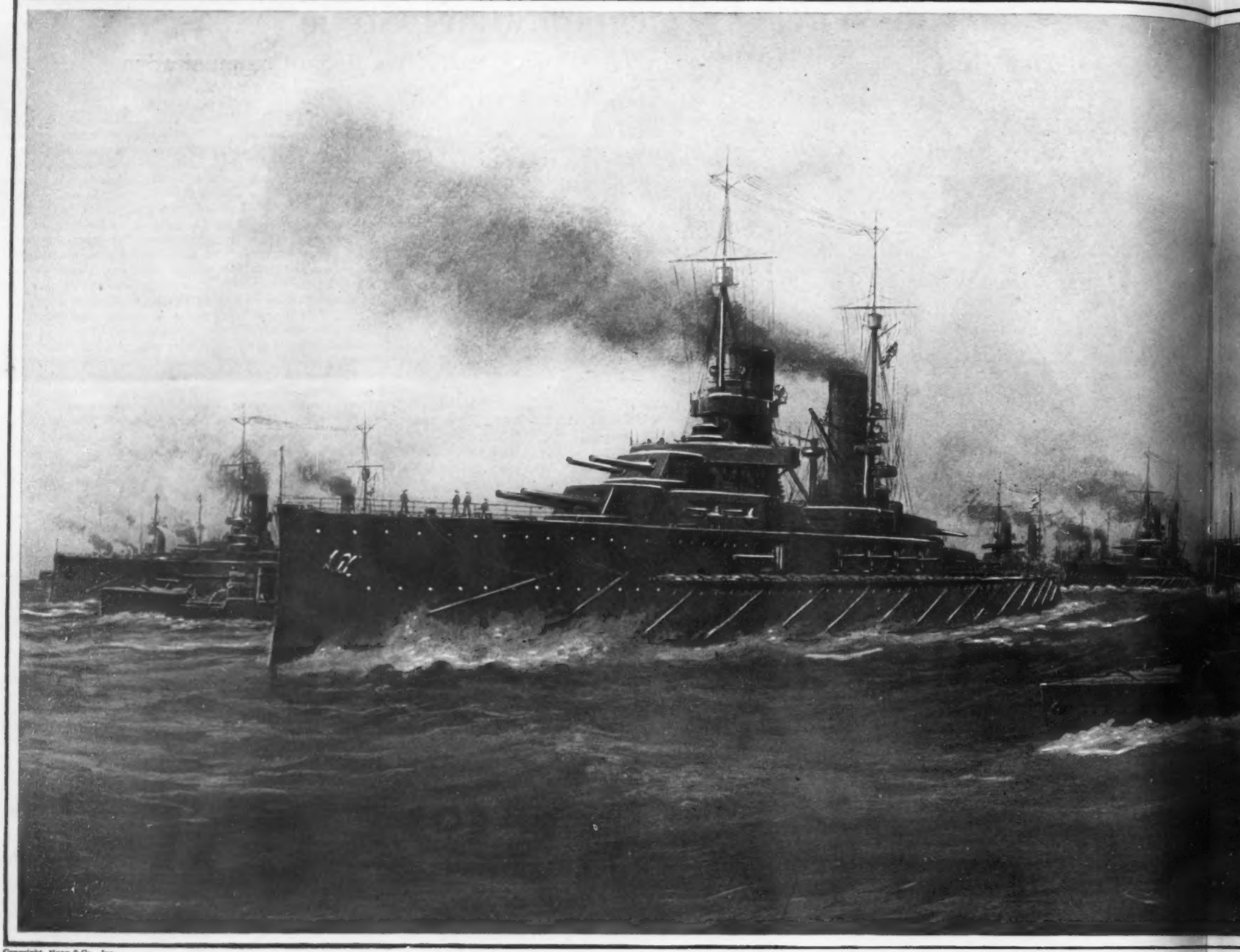
2255 Bellfield Ave.,

Cleveland, O.

[The suggestion that warships be used in the Merchant service is not new. The objection to such use of 35-knot battle-cruisers is that of its enormous cost. The horse-power of these ships is to be 180,000. At 35 knots, even for a three or four day passage they would burn 10,000 tons of coal or its equivalent in oil.—EDITOR.]

Saving of Office Stationery

CHAIRMAN B. M. Baruch of the War Industries Board has had drawn up the following seven suggestions to business men for the saving of office stationery. (1) Write single space, except between paragraphs. (2) Write on both sides in case of long letters. (3) Use half or two-third sheets for short letters. (4) Use 16-pound paper and the smallest sized envelopes required by the inclosure. (5) Use the backs of letters being answered for the purpose of making carbons. (6) Use post cards for acknowledgments. (7) Watch your waste baskets and use the soiled sheets and backs of envelopes for scratch pads. These suggestions are along the lines of those recently adopted by Goverment offices in Washington, and their adoption, it is believed, would result in the saving of a large tonnage of high-grade paper and aid the Government in securing its requirements of paper.



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The fleet of German dreadnoughts, battle-cruisers and [illegible] cruise

The Surrender of the German Fleet

The Second Most Powerful Fleet in the World Surrenders, Without a Fight, to Admiral Beatty

THE naval student would search the annals of naval history in vain to find a parallel to the surrender of the German fleet, which took place on November 21st, 1918. This dramatic ending of the Kaiser's dream of future dominion of the seas was distinguished from any previous submission of the kind, first, by the great size and power of the fleet that was given up, and, secondly, by the fact that it submitted without a fight. It has ever been one of the proud boasts of the naval fighting man that he is either prepared to fight to the very last and go down with his flag, or, at the most, that he will haul down his flag only when his crew is decimated, his batteries dismounted, and his ship battered beyond all possibility of successful fighting.

Ye shades of Nelson and Paul Jones! With what bewildered amazement would they have gazed upon that far-flung double line of British and American ships, and witnessed the stately dreadnoughts, the fast cruisers, and half a hundred destroyers of the German fleet steaming down through the line for internment in an enemy port. We can imagine these gallant captains of the "never surrender" type asking in wonderment, "What manner of naval men are these?" and we can see the expressions, first of incredulity, then of horror, and finally of utter disgust, chase each other across their features, as they learned of the four long years of immobility in German ports, of the bombardment of seaside resorts by battle-cruisers, and of the supreme atrocities of U-boat warfare. In the very magnitude of this treachery and cruelty they would find, as we find today, the explanation of that shameful surrender, *en masse*, and without firing a shot, of the second greatest navy in the world. Also, they would understand why it was that the German fleet was received between lines of Allied ships, whose guns were shotted and whose range-finders, carefully trained upon the German vessels, registered the changing distance.

And they would understand, as all the world does today, that Germany had only herself to thank for this crowning humiliation.

Although the public is thoroughly familiar, through press correspondents, with the details of this epic surrender, we will repeat here its salient outlines, if only to have the event recorded in the files of the SCIENTIFIC AMERICAN.

The following description from the *American* was written by the International News Service Staff Correspondent, D. M. Edwards, who was present at the surrender, aboard the U. S. S. "Wyoming."

"The surrender of the German fleet of 71 first line vessels was carried out with the precision of clock-work and there was not the slightest untoward incident to cause any excitement.

"While the Germans were giving themslves up 50 miles out in the North Sea, dirigible balloons and airplanes drifted through the sky overhead. Of the 71 German vessels 14 were heavy ships, seven light cruisers and 50 destroyers.

"The Germans, with guns trained fore and aft, but without any ammunition in them, sailed right into the open arms of the British, American and French fleet. The men-of-war were decked out with German flags, but there was no fight left in them. Every battle flag on the Allied fleet was flying and each man was at his battle station. Every turret was ready to open fire and every range-finder was giving the exact line of the approaching Germans ships.

"The Allied fleet, commanded by Admiral Sir David Beatty of the British Grand fleet, was composed almost entirely of British ships, with the American Sixth Battleship Squadron and a French ship. The fleet sailed from Firth of Forth at 2 o'clock this morning for the rendezvous.

"The destroyers departed last night, moving out by the score. The fleet then departed. It steamed northward and then turned east in double columns six miles apart. The northern column flew red burgees, the southern column flew blue. Leading the fleet was the British ship 'Cardiff.'

"The American squadron had the fifth place in the northern line. It consisted of the 'New York,' 'Texas,' 'Arkansas,' 'Wyoming' and 'Florida.' It followed in the wake of the fifth British battleship squadron composed of 'Barham,' 'Malay,' 'Valiant' and 'Warspite,' which took part in the famous battle of Jutland. On board the 'New York,' which is the flagship of Captain Beach, were Admirals Sims and Hugh Rodman.

"Following the American squadron came the British second battle squadron made up of ships of the 'Thunderer' type and just preceding the 'Queen Elizabeth' upon which was Admiral Beatty.

"Just back of Admiral Beatty's flagship came the great battle-cruisers 'Lion,' 'Princess Royal,' 'Tiger,' 'Repulse' and 'Renown.'

"The southern or blue column was led by the third light cruiser squadron with the vessels of the 'Chatham' type; then the 'Vindictive' and 'Minotaur.' Next came two more battle squadrons, followed by a battle-cruiser squadron made up of the 'Australia,' 'New Zealand,' 'Indomitable' and 'Inflexible.'

"Starting out in a haze, the Allied ships reached the rendezvous a little ahead of the schedule, so swung around in a circle, waiting for the Germans to come up. Suddenly a young officer, who had been peering intently to sea, exclaimed to the commander of his ship:

"'Unknown ship bearing off the starboard bow, sir.'

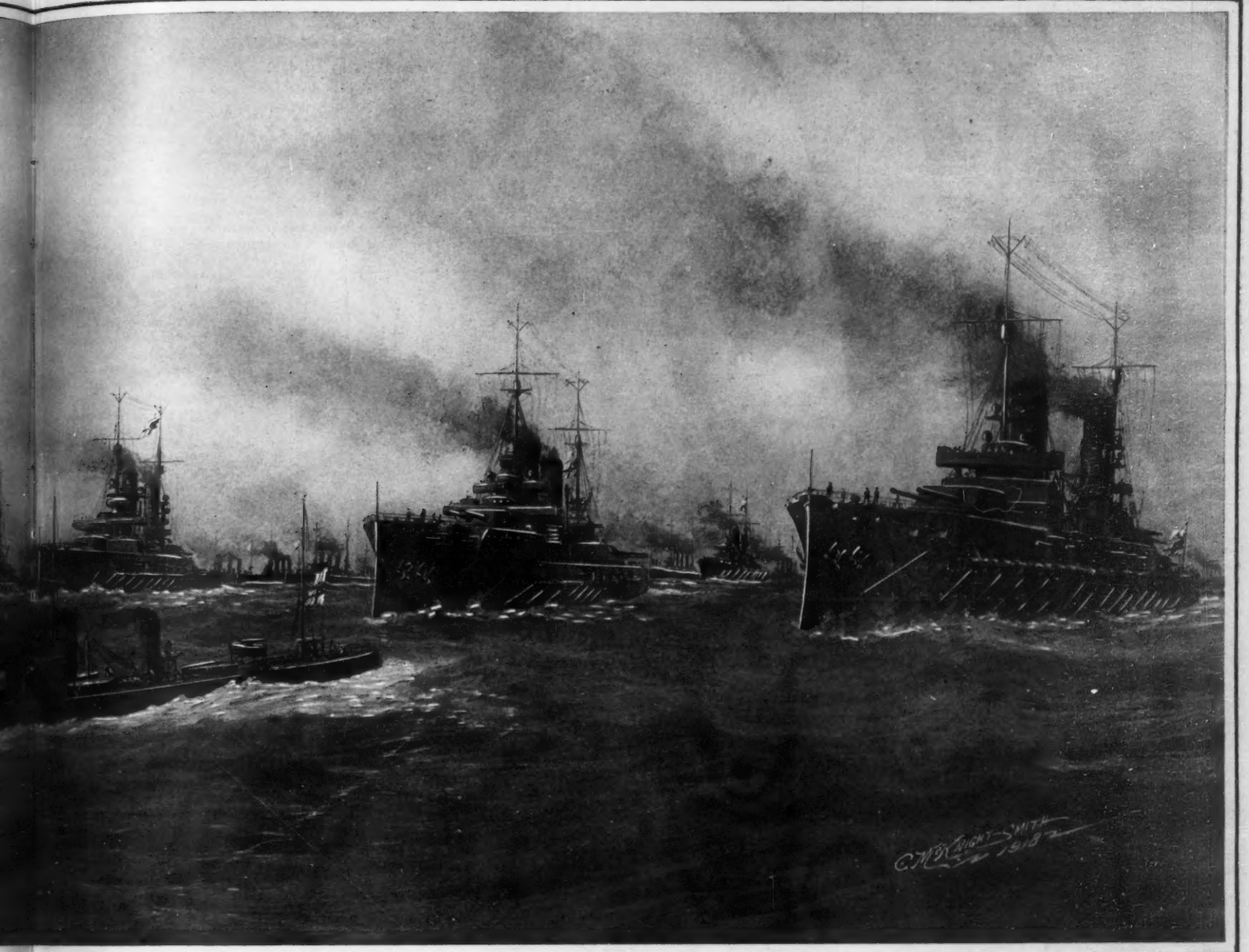
"'That must be part of the German fleet,' replied the commander.

"Soon a big, gray smoking ship came up from the east through the haze, and it turned out to be the leading battleship of the surrendering fleet.

"It bore the flag of Rear-Admiral von Reuter, commander of the whole German force. In a long column the German vessels passed between the two lines of Allied ships.

"In the German fleet were the 'Frederick the Great,' the 'King Albert,' 'Kaiser,' 'Crown Prince William,' 'Kaiserin,' 'Bayern,' 'Markgraf,' 'Prince Regent Luitpold' and the 'Grosser Kurfuerst' in the first detachment. They looked docile enough, although they seemed to be hugging each other closely.

"Then came the battle-cruisers 'Seydlitz,' flying the broad pennant of Commodore Tagert; 'Von der Tann,'



...and ... cruisers surrendered to Admiral Beatty on November 21st

'Moltke,' 'Hindenburg' and 'Derfflinger.' The last two ships were great vessels nearly 700 feet long with the smoke pouring from their huge funnels. They looked as formidable as anything in the Allied fleet.

"Half a mile back of the battle-cruiser squadron came the light cruiser 'Karlsruhe' flying the pennant of Commodore Harden; the 'Frankfort,' 'Emden,' 'Nürnberg,' 'Brummer,' 'Koln' and 'Bremse.' Practically all of the light cruisers appeared to be new ships."

The battleships, battle-cruisers and light cruisers were followed by 50 destroyers, steaming in four parallel lines.

At the same time there commenced, at Harwich, on the east coast, the surrender of 160 submarines."

As to the quality of the surrendered fleet, there can be no dispute; for it includes the very latest of the battleship, cruiser and destroyer fleets—ships which are free from the defects which marked the earlier attempts of Germany to build up a first-class fighting force. Thanks to the policy of von Tirpitz, who believed that great volume of fire was more valuable than weight of fire, the earlier German ships, both in the battleship and cruiser, and even in the destroyer classes, carried guns that were considerably lighter than those mounted by contemporary ships of the same classes in other navies. Thus, at the opening of the war the standard gun in the main batteries of German battleships was an 11-inch piece; in the cruisers, a 5.9- and 4-inch gun, and in the destroyers, the 3-pounder. In the later German ships, commencing with the "Thuringen" class of 1909, the 12-inch gun makes its appearance; but at the opening of the war there was no heavier gun than this mounted in the German dreadnoughts. Corresponding ships in the Allied fleets mounted nothing less than the 12-inch, and the French, American and British fleets, were carrying guns of 13.4-inch, 14-inch and 15-inch caliber.

If there was another broad defect, it was the crowded conditions on the German capital ships, the allotment of batteries, torpedo tubes, and general gear, to say nothing of the size of the crews, being larger for a given displacement than would be allowed in British and American vessels.

There can be no denying, either, that the Krupp guns are of excellent quality, and judging from the amazing rapidity with which the German dreadnoughts delivered their broadsides in the Jutland battle, and the accuracy of the fire, at least in the earlier stages of the engagement, it is unquestionable that they had worked out the problem of director-fire satisfactorily, and that their optical gear, in the way of range-finders, telescopes, etc., was of a very high order. The British noticed that invariably the German fire at the outset of an engagement was rapid and accurate; but that, as soon as they themselves got the range of the German ships and began to land on them, the fire fell off and became very irregular and of relatively poor quality. This would indicate that they possessed some mechanical or electrical system of range finding, which made no provision, in case of heavy damage aboard ship, for individual gun-pointing.

Unquestionably, the Germans achieved the very greatest success in what, after all, is perhaps the most important of the elements which go to make up an effective fighting ship, namely, that of flotation, or what might be called comparative unsinkability. The underwater subdivision of their ships was worked out with great intelligence and skill. The double bottom was deep and the anti-torpedo spaces along the sides of the ship were unusually wide and well subdivided. To the mind of the writer, it was this feature which enabled the German ships in the battle of Jutland to take the terrific punishment which they received from the 13.5 and 15-inch guns of the British fleet, without going to the bottom. Admiral Jellicoe's report speaks of their registering on ships of the "Kaiser" and "Koenig" class and putting from five to seven successful straddles across individual ships. Captain Persius says that "the losses of the German fleet were enormous, and on June 1st it was clear to every thinking man that the Skagerrak (Jutland) battle must be the only general engagement of the war." Subdivision saved many a ship on that day. This conclusion is further borne out by the extraordinary case of the battle-cruiser "Goeben," which it is now reported was found to have been struck altogether by five mines. Since there were no facilities for underwater repairs, it seems to be a fair inference that she was able to sustain this damage, even had it been done at one and the same time. The description of an eye-witness speaks of the inner bulkheads as bulging inwards under the pressure of the gases, but being of such excellent material that they did not break.

MAJOR UNITS OF THE SURRENDERED GERMAN FLEET

Dreadnoughts	Displacement	Speed	Best Armor	Guns	Date of Completion
Bayern	28,000 tons	22.5 knots	14-inch	8-15"; 16-5.9"; 12-3.4"	1917
Koenig	25,800 tons	22 knots	13¾-inch	10-12"; 14-5.9"; 10-3.4"	1914
Grosser Kurfuerst	25,800 tons	22 knots	13¾-inch	10-12"; 14-5.9"; 10-3.4"	1915
Markgraf	25,800 tons	22 knots	13¾-inch	10-12"; 14-5.9"; 10-3.4"	1915
Kronprinz Wilhelm	25,800 tons	22 knots	13¾-inch	10-12"; 14-5.9"; 10-3.4"	1915
Kaiser	24,500 tons	23 knots	13¾-inch	10-12"; 14-5.9"; 12-3.4"	1912
Kaiserin	24,500 tons	23 knots	13¾-inch	10-12"; 14-5.9"; 12-3.4"	1913
Koenig Albert	24,500 tons	23 knots	13¾-inch	10-12"; 14-5.9"; 12-3.4"	1913
Friederich der Grosse	24,500 tons	23 knots	13¾-inch	10-12"; 14-5.9"; 12-3.4"	1913
P. Regent Luitpold	24,500 tons	23 knots	13¾-inch	10-12"; 14-5.9"; 12-3.4"	1913
Battle Cruisers					
Hindenburg	27,500 tons	28 knots	12-inch	8-12"; 12-5.9"; 12-3.4"	1916
Derfflinger	26,500 tons	27 knots	12-inch	8-12"; 12-5.9"; 12-3.4"	1914
Seydlitz	25,000 tons	28 knots	11-inch	10-11"; 12-5.9"; 12-3.4"	1913
Moltke	23,000 tons	28 knots	11-inch	10-11"; 12-5.9"; 12-3.4"	1912
Von der Tann	20,000 tons	27 knots	9-inch	8-11"; 10-5.9"; 16-3.4"	1910
Scout Cruisers					
Bremse	4,100 tons	35 knots	.....	4-5.9"; 8-4.1"	1918
Brummer	4,100 tons	35 knots	.....	4-5.9"; 8-4.1"	1918
Emden	5,400 tons	30 knots	.....	10-5.9"; 4 anti-aircraft	1916-17
Karlsruhe	5,400 tons	30 knots	.....	10-5.9"; 4 anti-aircraft	1916-17
Nurnberg	5,400 tons	30 knots	.....	10-5.9"; 4 anti-aircraft	1916-17
Frankfurt	5,400 tons	30 knots	.....	10-5.9"; 4 anti-aircraft	1916-17
Koln	6,300 tons	33 knots	.....	2-8.2"; 6-5.9"	1916-17
Koenigsberg	5,400 tons	30 knots	.....	10-5.9"; 4 anti-aircraft	1916-17

The latest and most important ship of the surrendered fleet is the "Bayern," laid down early in 1914 and completed during the war. She is a vessel presumably of 28,000 tons and was designed to carry eight 15-inch, 45-calibre, 16 5.9-inch and 12 3.4-inch guns. The next class in importance is the "Koenig" ships, including the

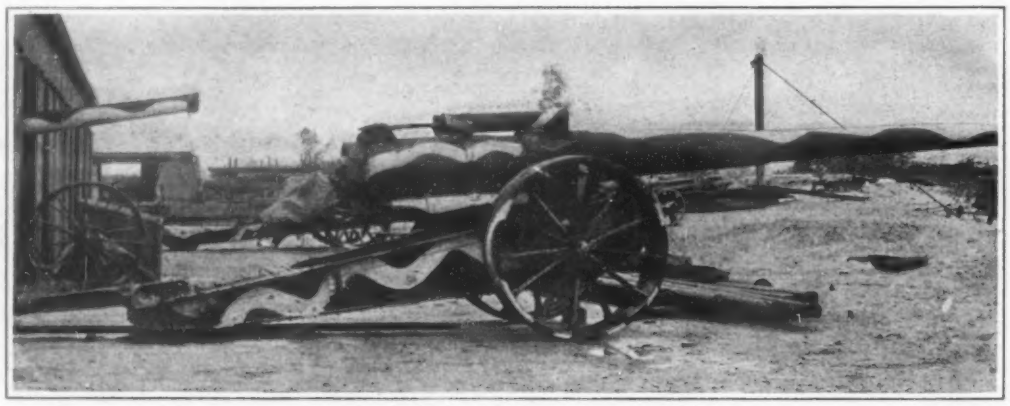
(Continued on page 466)

Gun Camouflage

The Gentle Art of Placing Batteries so the Enemy Can't Find Them

By C. H. Claudy

INASMUCH as a certain armed host was once concealed inside a wooden horse which was presented to the innocent defenders of Troy, to the lasting glory of the ancient camoufleurs and the ending of the siege of that city, it is idle to say that camouflage was invented by the French. But certainly they have developed its spirit as well as its letter as no army before theirs has ever done. Very early in the war the wily Germans gathered that camouflage for hidden batteries was a good idea. With their facility for assimilating ideas originated by others and improving on details, German camouflage immediately became a model. But also with their fatal facility for ignoring the spirit beneath an idea, it took them some time to arrive at what is now generally understood as the very first and most cardinal principle of camouflage as far as big guns are concerned—namely, that not a sod be turned, not a stroke of work be done until the battery position has been concealed by a camouflage. Until the German army learned this, there was considerable and unexplained mortality among her batteries. Be they never so carefully concealed, many of them were destroyed before they had even opened fire. Finally some more than usually bright Hun mind dropped upon the fact that it was no use to conceal a battery after its location was known, and that a pile of new made earth somewhere would perhaps give even a "stupid pig of an Englander" the idea that said earth had come from somewhere, which "somewhere" might be worth locating.



Long range, high velocity gun in its war paint

So for a long time no Allied battery has been emplaced save under the strictest of camouflage protection. This means not only the most perfect possible from a material standpoint, but a special camouflage discipline which is enforced in gun crews. For a battery, be it never so carefully hidden, can be discovered as well by the uncovered activities of its personnel, as by ineffective screening from aerial observation.

Give any commander of any battery the choice between a reasonable protection of his guns such as might be afforded by high earthworks or a range of hills, and complete concealment with no protection, and he will unhesitatingly choose the latter. "A battery seen is a battery lost" is a very good working maxim for modern gunners, and they hew to this line very closely indeed.

Naturally, before a battery can be successfully concealed from the enemy it is essential to know what things most readily give its location away. Outside of spies, information from prisoners and such indications of its position and location as the enemy may obtain from getting ranges upon a battery by the sounds it makes, there are six things specially to be guarded against by those who locate and use a battery. These are shadows, traces of earth works, any indication of travel such as tracks, paths, roads, rails, etc., which were not always upon the terrain, movements of personnel, blast marks and flashes of guns and anything which may appear in a photograph made subsequent to a battery's location, which would not appear in a photograph made of the same terrain prior to its installation.

It is necessary to consider these things with relation to each other as well as alone. Thus, it may be perfectly possible to put a battery into position so camouflaged that it will appear neither to aerial observer, nor of itself, in any enemy photograph, and yet give itself away by the long shadows its emplacements throw in early morning or late afternoon.

Disturbed ground shows up in aerial photographs with great clearness. But not only is it necessary to get rid of the excavated earth in such a way that it will not betray the presence of the battery. A hostile aerial observer finding a new made pile of earth on the landscape is very apt to wonder where it came from and why it is where it is . . . and the less of such wondering he does, the less likely is the newly placed battery to be discovered.

Nothing about a battery is so sure to give it away as paths. Paths show up in an aerial photograph with great distinctness. Equally impossible is it to have a battery anywhere and not make paths. Hence it is that a battery put down where a path already exists, said path being continued in camouflage right over the hidden battery, is something to be desired. If this is impossible, the inevitable paths are not permitted to stop at the battery but continue on to somewhere, anywhere—so that they apparently exist for some other purpose than their real one. They are joined to other paths, roads, a house, village or other natural object to which a path would naturally go. The enemy's photograph may well show a path today where was no path last week. But inasmuch as paths do exist for other purposes than to lead to batteries, the mere presence of a path is not necessarily suspicious. It is a new path which runs to a certain apparently vacant space and stops there that causes the hostile artillery to develop sudden activity.

Men must not dig emplacements save under camouflage cover of some kind. One or two men can do what they please and hide when the drone of the black cross plane warns them of observation. But a large working party cannot screen itself by hiding—it must be hidden at work.

Rear view of the gun shown above

Gun muzzles are frequently close to the ground. The result is a blast mark on the earth, than which no sign is more characteristic upon airplane pictures. Hence, they must either be prevented or eliminated as fast as made. It was known that there was a regular flash service in the German army, and that their methods of locating batteries by their flashes is well-nigh perfect. Hence, in exposed positions at least, concealed batteries were obliged to conceal their flashes at night—and all this is part of camouflage.

In selecting a position in which to emplace a battery, much care is given to picking one which will be possible to camouflage. For instance: is there a choice between bare ground or a well-grassed field, the former, not the latter is chosen. Painted burlap looks much more like bare ground than does a leafy screen like green grass. If a wood is available, camouflaging is easier than in the open, but woods are sometimes very dangerous places for batteries. Gas shells are extra deadly when they land in a wood, because the gas clings to the leaves and boughs. Cloud gas, on the contrary, avoids woods and is apt to sweep over it. Of course, no one knows when a German is going to use a gas shell, but in a sector where no gas shells have been used, a wood is a much more welcome place to a battery commander than in a sector where Fritz has the phosgene habit well developed.

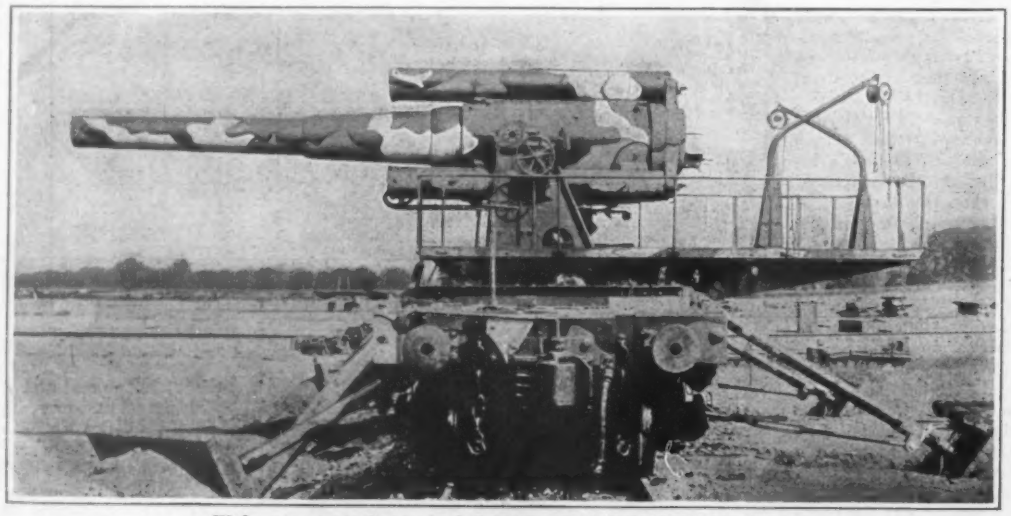
In emplacing the gun the ground is first sketched, because every bush, tree or other object of any size which is to be moved or removed must be replaced with a camouflage substitute. Then, as stated, before a single spade is used, some concealment must be effected.

There are three means. A screen may be erected which hides the object or the work, the screen itself being perfectly visible as such. The screen may be a simulation of nature—as for instance, woven wire covered with leafy branches when working in open woods. Finally, concealment may be effected by distraction—emplacing a false or dummy battery with great and unconcealed activity at one spot, and the real battery some distance away with carefully concealed activity, has fooled the enemy more than once.

The "frank screen," as the first method is called, is used to conceal from observation roads, tracks, trenches, and the like, water logged ground, over which guns and troops must pass and where trenches cannot be dug, battery positions, gun flashes, work in progress, work not yet camouflaged, earth dumps, and for the curious and interesting purpose of drawing enemy fire on nothing at all, thus making him waste ammunition. He is too keen for much of this, however, as firing at a large screen on the chance that there *may* be something behind it is too large a chance to take with ammunition at a premium.

A successful screen must be light and easy to erect, strong, able to resist weather and should be flimsy enough not easily to be damaged by shell fire. Some screens are just screens—others are themselves camouflaged—"camouflaging the camouflage," in other words, to seem like something else. Screens are made of wire netting with grass, with brush, with canvas strips, brush or grass on wires strung between fence posts, canvas or burlap, or jute or cocoanut matting.

Of course, no screen is absolutely opaque except an opaque one. Thus, corrugated iron won't let the light through under any circumstances. The thickest of canvas will betray itself under certain conditions of sunlight. On the other hand, the thinnest and flimsiest of screens which is perfectly transparent to a man 50 feet from it, may with proper conditions of background and lighting, serve as well as a stone wall in concealing movements behind it. It depends upon conditions, and hence it is that we have a camoufleur corps to help out, in emplacing batteries, officers who, no matter how much they may have studied the subject, have too much to do in running their guns and making hits with them to become real experts on artful concealment.



Elaborate camouflage of a big fellow and his railroad mounting

In no previous war has paint played so large a part as in this one. When camouflage first made its appearance, there was a howl from all those whose dignity was injured by turning their pet working tool into a hideous nightmare of color and riot of splotches. Ship captains objected to directing the:

(*Continued on page 467*)

Side Lights on Rehabilitation

THE problem presented by the crippled soldier, always a timely topic during the past four years, is for us made doubly so by recent Congressional action establishing a bureau for restoring the capacity for work to those of our boys who suffer mutilation as their contribution toward freeing the world of the Vandal scourge. We and our contemporaries have on more than one occasion reported the wonderful work of the French surgeons and prosthetists, led by Dr. Amar; and indeed, this work, along with wireless and airplanes and 20-mile guns, has perhaps come to be accepted by a rather sophisticated public as one of the commonplaces of current life.

It is now thoroughly understood that loss of a leg, an arm, an eye, or even both legs, arms or eyes, does not necessarily bar a man from becoming again a useful citizen, after proper training. Rehabilitation and reëducation are words which we meet on all sides. But most of the discussions have to deal with the physical side alone of the problem presented by the crippled soldier; and this is not sufficient. In order to handle him successfully, we must inquire into his psychology.

With half of one arm and quarter of the other, tying his tie is one of the least surprising things this man does

The cripple in civil life is divided into two classes; the soldier will possess the characteristics of both, and both must accordingly be considered. First, we have the man who, as the result of his accident, has received a financial compensation frequently amounting to some thousands of dollars. In almost every case such a man either burns his money up in having a good time, or decides that it is incumbent upon him to run his little stake up to a big one by engaging in trade.

In the latter event he usually selects a grocery store, a pool parlor, or a saloon as the channel for his entry into the world of commerce. This is unfortunate. The first-named business is one that calls for a master merchant; there are more failures here than in any other line. And if the other alternatives demand no great amount of business acumen, they certainly require a great deal of the sort of personal magnetism that will attract the men who frequent these places. The chances are heavy that the self-styled business man is totally deficient in the qualifications for any of these lines; hence failure and financial collapse usually overtake him within a year, and place him on the same footing with the man who has actually squandered his little fortune.

However the victim has got rid of his money, it takes him perhaps six months or a year longer to realize that he has no funds, no friends, and no resources within himself. Up to this point he would have scorned advice, and was certain that he needed no assistance. But now he awakens to the seriousness of his situation; so one may offer him a job, where up to this time, if he were offered anything at all, it must necessarily have been a position. His experiences have done him good, however. Mr. H. J. Morris of Kansas City, who employs cripples exclusively in his factory and store, and on whose experience much of this discussion is based, goes on record that when a man of this type is found, who has not gone permanently down and out through the ministrations of John Barleycorn, it is not necessary to take him on trial or put him on probation; he makes one of the steadiest and most reliable workers that could be wished for. He has been up and down; given another chance to make good, he possesses the sense of values and is willing to put all he has into every effort.

A second class of unfortunates includes those who lose a limb from disease or as the result of accident from which no compensation has been received. Such a man is spoiled in a different manner. He is given the best of hospital care and attention, and the protecting hand of the community extends throughout the period of convalescence. When he gets around on crutches or with an empty sleeve, there is always someone to lend a helping hand in getting on or off a car, or in doing anything that calls the deformity into evidence.

Loss of both lower legs has robbed this building inspector of none of his activity

But the day of reckoning is near. Sooner or later the mutilated member is tricked out with an artificial piece, properly applied. Then, so far as appearances

(*Continued on page 467*)

The Flying Tank of the Germans

THE armored plane, which has been referred to as the flying tank, has appeared on various occasions in the great war, usually on the German side. Such attempts to protect airmen and engines have generally proved a failure, however, for the reason that the loss in speed and climbing ability has more than offset the gain in protection against hostile rifle and machine-gun fire from the ground. Indeed, such machines have only too often fallen victim to artillery fire from the ground.

A typical armored plane designed by the Germans for operations against troops on the ground was recently brought down by the Americans, just prior to the armistice. From the drawing which appears on the opening page of this issue, it will be noted that this flying tank is a two-seater and carries three guns—one firing directly ahead, one mounted on a tourelle, and the third arranged to fire through a well in the floor at targets on the ground. Such a plane is intended for attacks on moving troops along highways.

Birds at the Battle Front

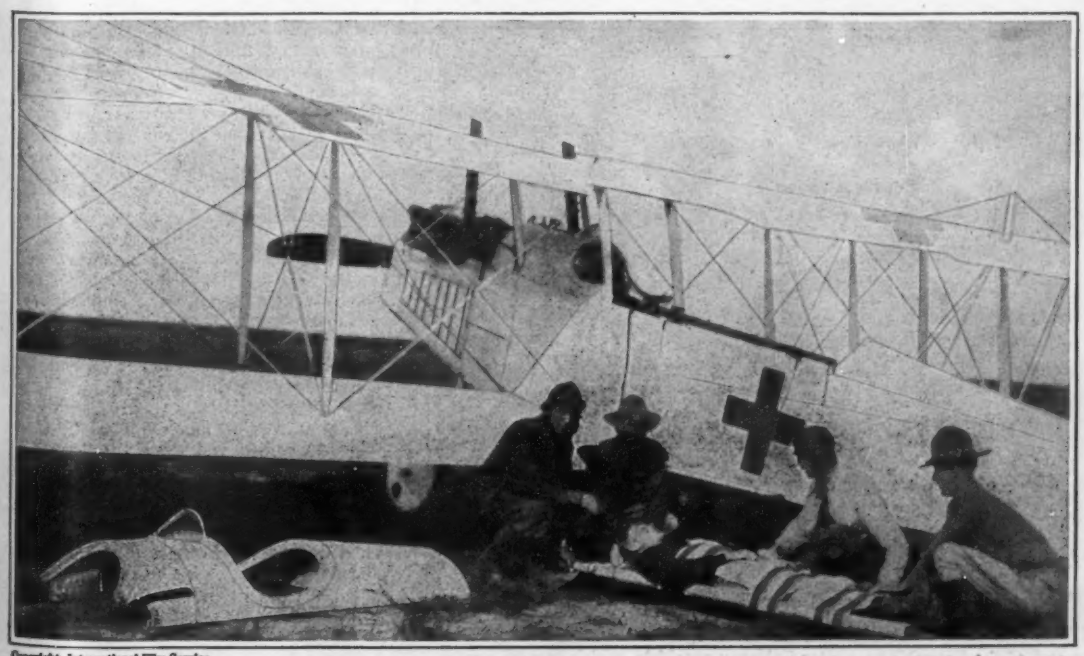
ACCORDING to the *American Museum Journal*, birds at the European battle front pay surprisingly little attention to the noise and confusion around them. In one case quoted, when a shell burst through the roof of a shed in the rafters of which swallows were nesting, the birds quickly took advantage of the new opening when flying back and forth to feed their young. Masked gun-sites are favorite nesting places. A British ornithologist records that a brood of four young blackbirds was hatched within four feet of the muzzle of a gun. A pair of hedge swallows had their nest in the hub of a broken wheel, continuously under fire, and regularly fed their young without regard for the dropping shrapnel and bursting shells. It is stated, however, that droves of magpies have found the gunfire in France too much for their nerves and have taken refuge in England. Birds ordinarily pay little attention to passing airplanes, but an exception is noted in the case of jackdaws at St. Omer, which have been known to leave their homes in the church steeples and attack the newfangled denizens of the air.

Winged Ambulance of the United States Army

FOLLOWING the example of certain of the European armies, the United States Army has of late been experimenting with an aerial ambulance with the object of evolving a rapid and convenient means of transporting severely wounded soldiers from the battlefield to the base hospital.

As will be noted in the accompanying illustrations as well as in the cover drawing of this issue, the American winged ambulance is a modified Curtiss two-seater biplane, arranged with a removable top section in the fuselage, just back of the pilot's seat. The removable panel permits of readily placing the litter with its human freight into the airplane body; whereupon the panel is replaced so as to protect the wounded man from the cold and wind. The airplane, in this case, is painted white and marked with conspicuous red crosses so as to distinguish it from fighting craft.

In the latest forms of French flying ambulances the equipment is quite complete. Among the things carried are portable stoves, a complete X-ray outfit operating from a generator on the airplane, the necessary surgical instruments and supplies, and a simple tent. However, the French have been working on the problem of flying ambulances for upward of two years, and are therefore further along with the matter than we are at present.



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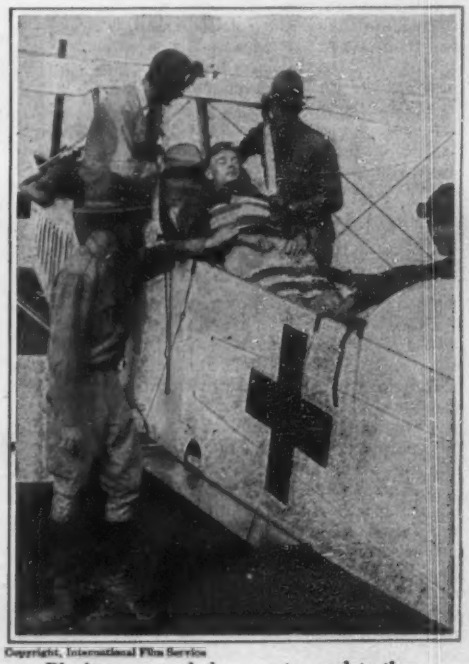
Airplane ambulance resting on the ground alongside a severely wounded soldier, showing how the fuselage section is removed to give access to the interior



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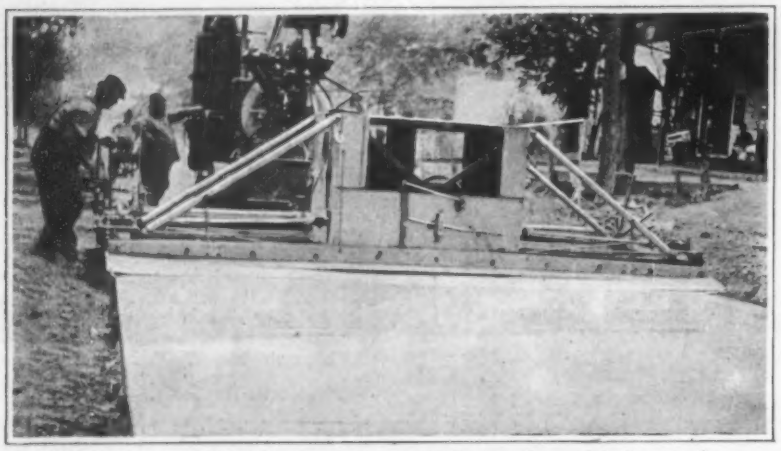
Placing a wounded man, strapped to the litter, into the flying ambulance

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts



New concrete road finisher at work on a 15-foot roadway, 6 inches on the sides and 7½ inches thick at the center

Close-up view of the new road finisher at work on a batch of aggregate which it handles to the best advantage

Producing Denser Concrete with a New Road Finisher

A CONCRETE road finishing machine that eliminates the voids in concrete and by the use of which the proportion of coarse aggregate may be increased considerably is the latest contribution toward concrete road building.

The new road finisher moves forward under its own power at a speed of about 7 feet per minute and backs up at a speed of 28 feet per minute. As the machine travels forward the strike-off spreads the concrete to the necessary height and proper crown. The tamper, located just back of the strike-off, tamps the concrete the first time over with a long hard stroke. The second time over a short, rapid, up-and-down movement is used, which may be decreased until it is subjecting the concrete to continuous agitation without applying pressure to the mixture. The stroke of the tamper is regulated by the operator and may be varied for different consistencies of concrete as well as for different stages of progress. The float, located at the rear of the machine, produces a smooth finish by sweeping a belt across the surface at a comparatively slow speed.

By subjecting the mixture to the continuous agitation caused by the tamper, the concrete is compacted and the air in it is brought to the surface. The larger stones and only enough mortar to cement them are brought together. Because of the agitating action of the tamper, a drier mixture can be used with the new finisher than would be possible where the work is done by hand. This, of course, results in a stronger concrete and produces a surface free from laitance, silt and light particles which float to the surface of a wet mixture.

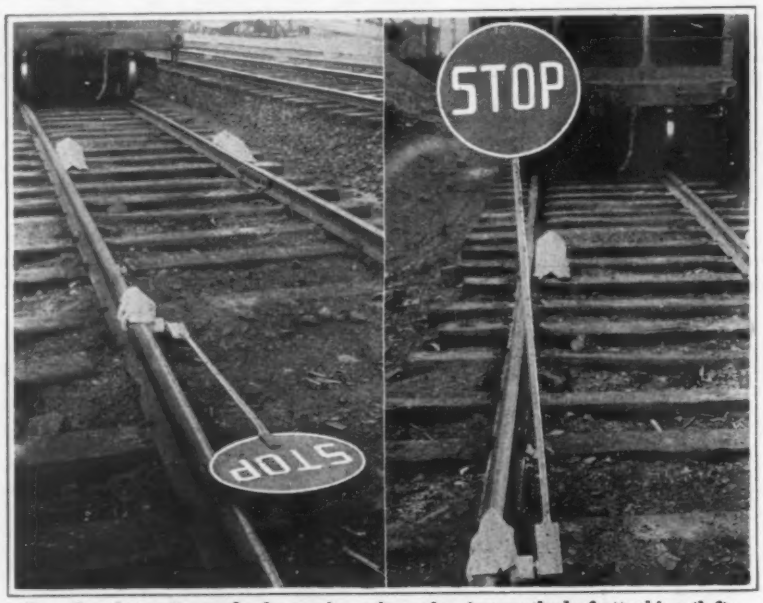
The new concrete road finisher is the invention of E. G. Carr of Cleveland, O., who conceived the idea while a contractor in California. This type of machine has already been employed on the construction of about 400 miles of California's famous highways.

Derailer to Protect Track Workers

THE story of how workmen have been seriously injured and often killed while at work under cars has been told again and again. The small red flag for years used as a danger warning, is frequently run into and knocked down. A derailer has been invented that is going to put a stop to most of the accidents to men working beneath standing railroad cars.

A derailer is placed on the rail and the sign shaft placed in a vertical position. A lock engaging the underneath side of the pate of the rail holds the derail securely and prevents it from slipping. If a car or engine should come in contact with the shaft of the derail it will tighten the lock and not loosen it. Further protection is arranged for by the use of a padlock which makes security doubly sure. The device is easily portable having a weight of 36 pounds. Shafts are used which extend over the center of the track as well. It is impossible to remove the "Stop" sign unless it is lowered and the lock pulled out so as to clear the locking bar. The sign can not be placed into a vertical position until the lock is pushed in so as to come in contact with the derail.

The inventor of the novel derailer, Mr. B. John Buell, a railroad man of experience, contends that a man is always looking for the line of rail rather than any other location on the track, and with the stop sign directly over this line, it is hard to miss seeing.



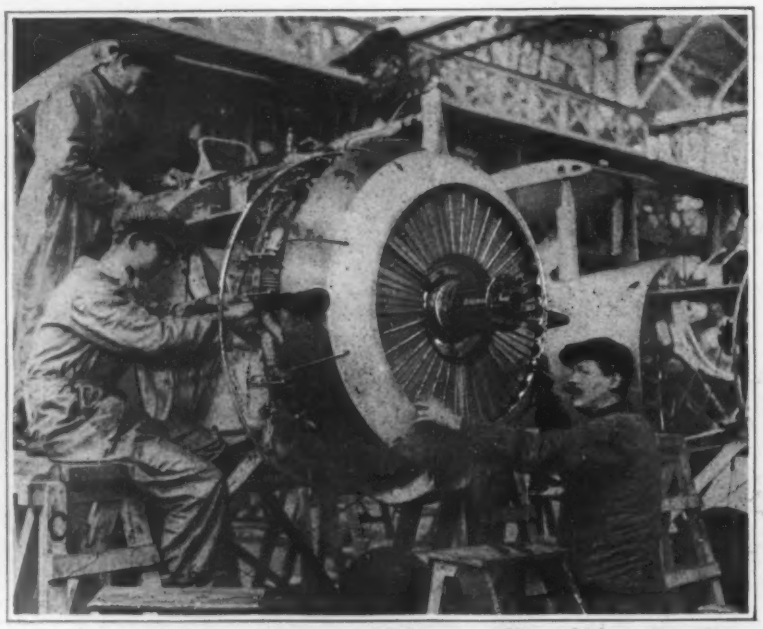
Derailer that safeguards the track worker, showing method of attaching (left) and final position (right), in which it is locked to the rail

How the Radial Engine Saves Space in the Fighting Airplane

ASIDE from the fact that it reintroduces the radial form of engine which was so much in favor during the early years of aviation, the Salmson reconnaissance machine of the French air forces is interesting in several ways. During the last few months of fighting in Europe, this type gave a very good account of itself in reconnaissance, aerial photography, and general utility work.

As will be noted in the accompanying illustration, the Salmson plane is equipped with a 250-horse-power Salmson engine which is simpler and shows improvements over the former Canton-Unné engine of the radial type. The development of high performance engines for war airplanes leads, undoubtedly, from the vertical model now so much in favor to the radial type; and because of this development the new Salmson engine may be a forerunner of many other radial engines. Compared with other engines now in use, the Salmson occupies but little fore-and-aft space, giving that much more room for passengers, fuel tanks, armament, and so on. The nine cylinders of this engine are water-cooled, the radiator being placed in front and provided with radial and adjustable vanes as shown.

The Salmson reconnaissance machine weighs 1,716 pounds empty, and carries a useful load of 1,122 pounds. It is capable of a speed of 111 miles an hour at normal altitudes, and climbs to 9,750 feet in 11 minutes and 42 seconds. All in all, the performance of this machine is excellent.



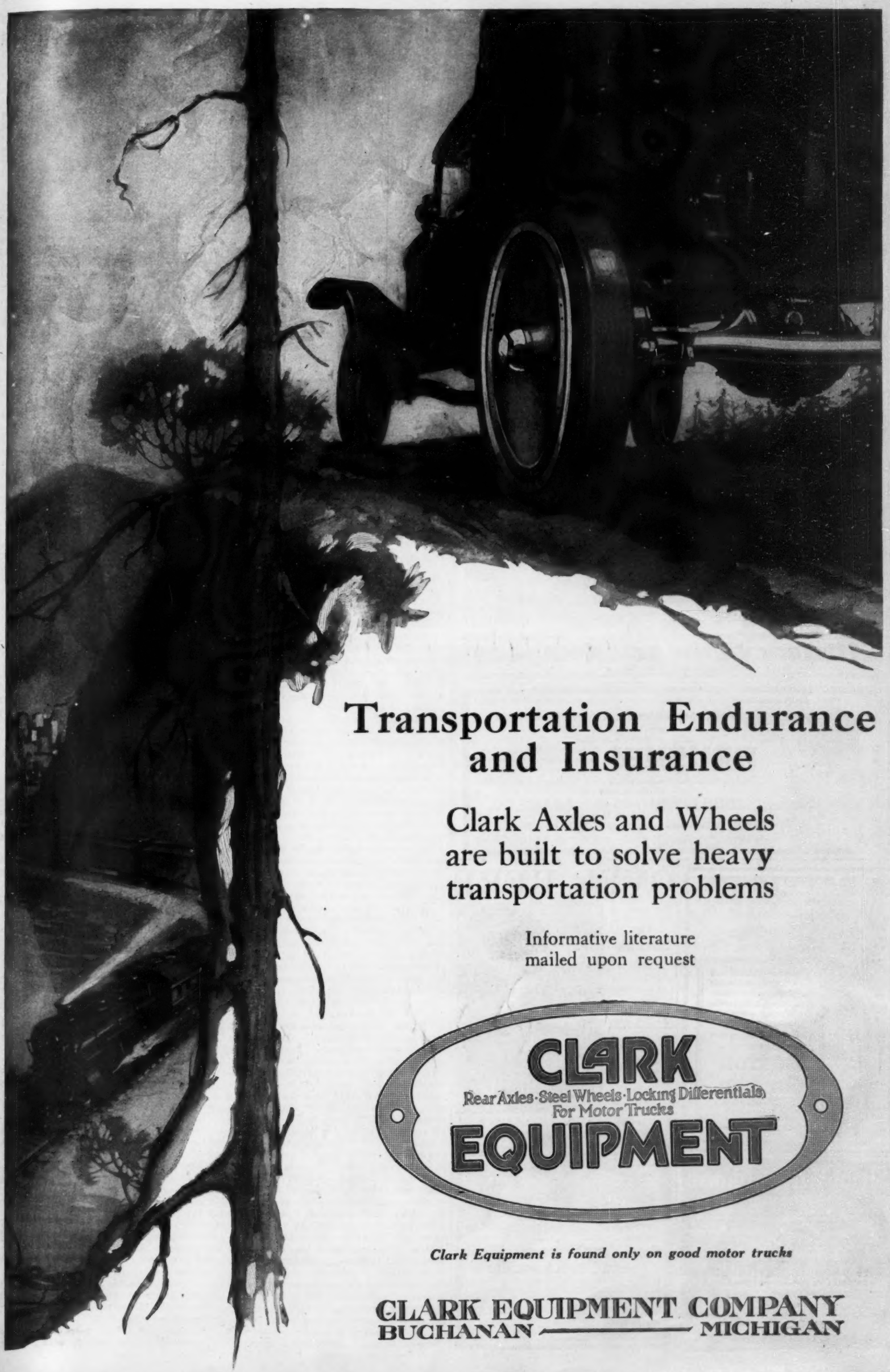
Engine end of the French two-seater Salmson machine, which carries one machine-gun forward and one in the rear

Notes for Inventors

Federal Court Decisions Concerning Patents

The Prior Art and Invention.—A patent for an improved pulley which provided for a flaring sheave, held invalid, not showing invention in view of the prior art—a pulley being one of the elementary mechanical powers. It is a matter of common knowledge that, if the groove on the edge of the wheel or sheave in a pulley block is sufficiently deep, it will carry a rope of a diameter slightly less than the groove without any corresponding opposite opening in the block in which the pulley is mounted—but with a corresponding opening in the block the groove in the wheel may be more shallow, and the rope pass through the groove with less friction than over a wheel with a deep groove. It is at this point that appellee's device comes into play, and its operation is illustrated in the hauling of logs. The primary object of the improvement is to produce a pulley which has but few parts and is efficient in operation. A mere change in degree is not invention. It does not show invention to enlarge a small pulley. —*Willamette Iron & Steel Wks. v. Columbia Engineering Wks. U. S. C. C. A. of Ore.*

Interlocking Patents.—Where patents were practically concurrent and copending, each one seeking to be contributory to the advance or change in the art, but referring expressly to each other and to the general purpose to be accomplished by all of them, the court, in considering the claims of one patent, must do so in view of the time and conditions under which the copending patents were brought out, in order to ascertain the true intent and construction to be placed on each.—*North American Chemical Co. v. Dexter. U. S. D. C. of Wis.*



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The Current Supplement

ONE of the results of the war has been to prematurely advance the matter of an adequate supply of food to a position of not only pressing, but of permanent importance. Ordinary, old fashioned methods of agriculture cannot replace the lost crops from hundreds of thousands of untilled acres in Europe, untilled for years, and the excess consumption of the vast armies in the fields; and the only way to meet present and impending conditions is both to bring additional areas under cultivation, and to increase production by improved scientific methods. In connection with the latter phase of the problem, the weather holds an important position, and in an article on *The Relation of Weather to Agriculture*, in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2240, for December 7th, outlines some practical methods of procedure that should be productive of important results. *Destruction from the Sky* tells something of the airplane bombing expeditions that produced such efficient results during the last few months of the war. It is illustrated by several photographs. The paper on *Meteorology in Relation to Aeronautics* is concluded in this issue. Our American army hat has become so familiar of late that the short story on *Making Hats for Our Doughboys* will not be out of place, and the large number of excellent photographs that accompany the article tell a story of their own. *Ignition Magneto Construction* gives a great deal of valuable information how this familiar piece of apparatus is constructed, how it is tested, and how the magnets are magnetized. The article is illustrated by quite a number of drawings that make the explanations in the text quite clear. Other articles of importance in this issue are *The Treatment of Cases of Shell-Shock*, *The Wax Palm and Its Uses* and *The Shortage of the Supply of Non-Phosphoric Iron in Europe*.

The Saving Grace of War

(*Continued from page 454*)

the hulls of steamboats, and injure all boilers into which any of the waters of the polluted streams are placed, but they do much harm to the submerged parts of Government locks and dams. Federal property is being injured to the amount of $25,000 a year on the Monongahela and not less than $32,000 on the Ohio. The presence, until recently, of the discharges from the acetic acid stills along the Hudson constituted a serious source of trouble to the war vessels of all nations which are constantly moored under the lee of the Palisades. And yet, when one company, at a cost of $5,000,000, has built a plant for the proper fermentation of kelp taken from the Pacific in order to get acetone for its munitions work, why should another concern empty the content of its acetic stills into the Atlantic?

Many makers of chemicals are already aroused to the practical need of conserving the corrosive liquids which they had been squandering in days of peace. The fumes from a chemical factory in upper New York state, which makes hydrochloric acid, had become such a nuisance that the authorities ordered the owners either to close up the plant or dispose of the noxious vapors. It did not take long for the chemists to devise an apparatus by which the hydrochloric gases were passed over lime and thereby produced chloride of lime, or bleaching powder, which commands a high market price.

All free acids could thus be converted into channels of usefulness. The discharge from chemical and industrial plants represents lack of thrift. One of the most typical instances of the extravagant methods which had prevailed in American industry before 1914, was to be found along the Passaic River. That classic stream, famed in song and story for its beauty, has become a loathsome ditch surcharged with oils, greases, chemicals and costly dyestuffs mingled in the effluent of factories and mills. There is now under construction a trunk sewer 27 miles long which will defile the harbor of New York with these millions of gallons of filth each day unless the Supreme Court of the United States interferes. In view of the approaching decision, the captains of industry in the valley of the Passaic are finding that they can remove many of the objectionable constituents of the sewage and either re-use them or retain them for their own processes. The manufacturer of woollens is realizing that the grease from fleeces is the precious lanolin, a healing salve. The bed of the stream is lined with sulfur black and anilines which the dyers are ceasing to cast upon waters from which they cannot return. The city of Paterson alone was flinging into the river 3,000 pounds of olive oil soap a day, of which 75 per cent could have been recovered.

The city of New York is no less an economic sinner than are her sisters across the Hudson. Year by year, despite the warnings of the War Department, she has been choking the fairway of the King of Rivers and the entrances to her piers with vast deposits of recoverable waste. How foul has become the bed of the Hudson could be seen only a few weeks ago when the Government was dredging the river off Riverside Drive preparatory to installing a repair yard for the Emergency Fleet. No one who did not witness the operation can have any conception of the filthiness of the matter brought to the surface nor of the odor of the gasses released. This mass of decay was composed of substances which not only can be rendered harmless but can be made to serve the nation's need. Even the portion which is of domestic origin is especially rich in nitrogen, an element upon which so much of the success of modern warfare depends that the War Department, in order to be ready for any emergency, is building enormous plants for the fixation of atmospheric nitrogen and is using every endeavor to get control of nitrogenous material.

Once there was an industry which poured a mixture shot with molten gold into the streams because it was black and ugly and seemingly useless. The fish died and were cast up to rot upon the banks The herbage for miles around was killed. Even when the coke makers conceived the idea of pouring their coal tar waste into pits, it followed the strata and destroyed the grass and the trees and their very roots. Then came the war and the demand for the black liquid from which the Germans had been gaining explosives and dyes, for with them the dye factory becomes over night the ammunition mill. Out of the once discarded waste, when the appropriate by-product ovens were made to take the place of the wastrel bee-hive type, came benzol and toluol in plenty. Out of such liquids as these the magic of chemistry began fashioning weapons to the hands of the war god. Our American dye industry, thanks to the swift urge of war, is now ably taking the place of the vaunted color works of Germany.

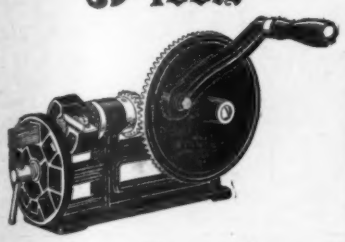
Now comes the paper pulp industry, bringing toluol. It had stores of the base of T. N. T. all the time but did not give heed. The valuable constituent was hidden in the corroding waste liquor with which our lakes and streams were until recent months befouled. In order to have a paper devoid of spots and grease splotches, the makers boil out the resins and oils from the spruce chips. To the top there rises the spruce turpentine, known as cymene, a godsend to munition makers and a marplot to paper mills. The pulp manufacturers of the United States gladly undertook the patriotic duty of conserving their waste liquors, which yield cymene, from which ammunition is evolved, as well as the antiseptic, thymol, employed in dressing the wounds of our soldiers, and other by-products which are of high value to our troops abroad.

One company is distilling from this waste of the vats 500,000 gallons a day of alcohol, which is identical with that obtained from the best grain and which bears no resemblance to the ill smelling wood spirits. This product releases cereals for food and provides a valuable fuel for the arts of peace and war. This cooking liquor can also be condensed to the consistency of molasses. The light brown compound which results is much in request by the foundries, which just now are overwhelmed by Government contracts. They are paying from 13 to 15 cents a gallon for it to mix with the sand of their molds. Its adhesive qualities insure the firmness of the impression and lower the percentage of defective castings. As a binder in core making it is unexcelled.

The sulfite pitch, as the trade calls it, is also in much demand as a filler for leather. It is making its way into varied usefulness in the tanning industry, and the manufacturers of rubber goods are wondering how they ever got along without it. Its stickiness commends it to the makers of coal briquettes. It is incorporated with the slack, which it holds together firmly if not exposed to too much moisture. As it contains many resins it adds to the fuel value of the briquettes, from which most other binders detract.

Road makers are also users of this forest by-product. They mix it with broken

Stanley Tools



Stanley Dowel and Rod Turning Machine

No. 77

A tool for Carpenters, Cabinet Makers, Pattern Makers, Furniture Manufacturers. In fact for anyone interested in woodworking.

It will not only cut dowels of varying sizes and length to perfect dimensions, but with it one can also form rods of practically any length.

Ready made or stock dowels have a tendency to warp and shrink, making them very unsatisfactory to use where a close fit is desired.

With this machine the workman can cut his dowels when he is ready to use them and furthermore of the same material as the wood being worked.

One cutter head complete for making dowels or rods ⅜ inch in diameter is furnished with each machine.

Additional cutter heads with cutters ¼, 5/16, 11/32, ½, 17/32, 9/16, 19/32 and ¾ inches can be furnished if desired.

A workman whose tool equipment includes one of these machines and a Stanley Doweling Jig can make doweled joints with surprising quickness and accuracy.

Call at your Dealers of Hardware and ask to see this machine

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With each Reminder is an extra filler

	5 in. x 5 in.	5 1-2 in. x 7 in.
Handsome Black Leather	$1.00	$1.50
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Ladies' Shopping Reminder, 2 3-4 in. x 5 1-4 in., with pencil and extra filler $1.00; in Patent Leather, $1.25

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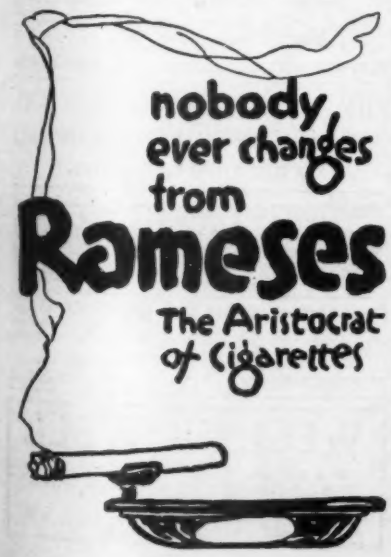


stone and slag when they are laying the foundations for a highway. For keeping down the dust, it is superior to crude petroleum. Coal oil has an unpleasant odor which dulls the edge of the enjoyment of motoring, while sulfite pitch has the aromatic scent of the woods.

One enterprising manufacturer is getting sulfite yeast. Although he has been fairly successful in turning out the little, compressed cakes, he cannot be sure always whether they will come out pure white or sullen purple. Both shades possess good leavening qualities, but there seems to be a prejudice against violet rays, even in bread.

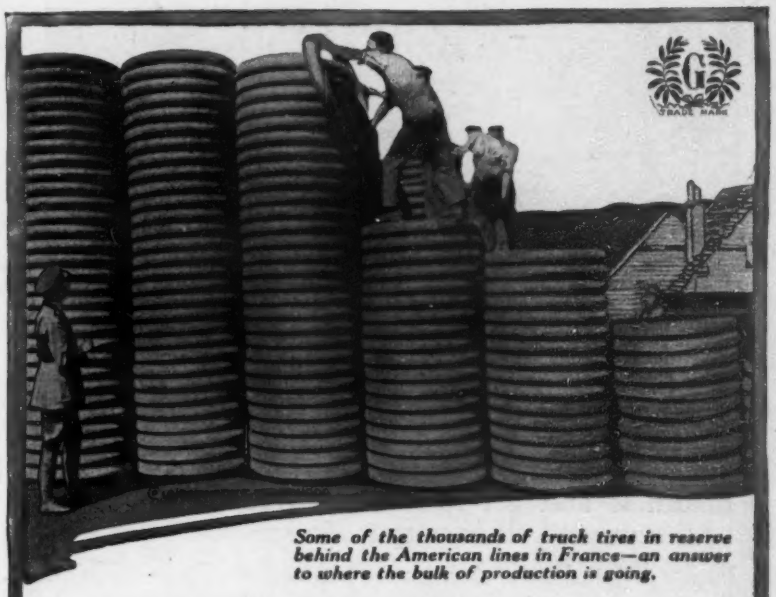
The problem of conserving tannery wastes had been considered from many angles by progressive men. The enhanced price of the product which goes into the making of harness, leggings and heavy shoes for millions of fighting men has encouraged the tanners to invest in substantial appliances for utilizing their refuse. The results have been most satisfactory. Much nitrogenous material can now be recovered, such as cuttings and scraps from hides and hair, which are quoted at a good price to manufacturers of ammonia and similar chemicals. There is probably in all industry no more offensive waste than those which come from the preparation of leather, nor any which could be made to yield a richer return, if properly treated. All trades have been prodigal in their use of water. If, before they discharged the aqueous waste from their factories, owners would observe due economy at the hydrant, the cost of separating the solid constituents from the liquid discard would be comparatively slight.

Results from a recorded test of four months at a tannery in Pennsylvania using the acid process, show the possibilities of conservation. Three million gallons in all were treated. For each side of leather, half a cowhide, 1.56 pounds of dry solids were recovered. The ammonia content of those solids averaged 6.47 per cent, after the sludge had been treated to render it soluble. According to the census report for 1914, the number of cow and horse hides tanned in the United States for the year was 20,867,620. The grand total of the hides and skins tanned for that period was 138,547,692. Based on these figures, the estimate is made that 60,000 tons of recoverable fertilizer, worth fully $1,360,000 are annually dumped by the tanners into the streams of the United States. Yet were it not for war conditions, it is improbable that the tanning industry would be putting in even the simplest recovery apparatus.

Owing to the meat scarcity much attention has been given lately to increasing the fish supply, not only from the ocean, but from the inland streams. Mr. George D. Pratt, Conservation Commissioner of New York, has been especially successful in obtaining the coöperation of owners of industrial plants throughout the Empire State. One company which was manufacturing screen wire, was polluting the Tioughnioga River with washings of iron shale and oil. It installed precipitation tanks and thereby saved its iron and recovered its oil and also helped its employes reduce their cost of living; for the fish are returning there.

The late John Bigelow, who lived for years on the banks of the Hudson at Malden, once wrote that the money value of the shad caught from the metropolis to Albany exceeded the revenue of the farming communities bordering either side of the river. Not only could the shad be induced to return in large numbers to their old northern haunts, but there is no reason why the sturgeon, once so plentiful that hundreds of fishermen lived by taking them and thousands found them a favorite food, should not also teem again in the upper regions of the Hudson. There are men living today who recall that this fine fish was once so abundant that the capital of New York was called Sturgeon Town and the useful denizen of its adjacent waters was known as Albany Beef. The freeing of Lake Champlain from the sludge of the paper mills brought back that delectable fresh water smelt—the ice fish, which last winter furnished a substitute for meat to many inhabitants of that region and filled the purses of fortunate fishermen.

When the Government takes charge of industry, it stands not on the order of the day. War is a serious business which demands a full measure of efficiency from those who engage in it. Peace may destroy the value of millions of dollars worth of real estate on either side of beautiful and stately rivers and make citizens walking in the parks gasp like gassed soldiers, but



Some of the thousands of truck tires in reserve behind the American lines in France—an answer to where the bulk of production is going.

When the Army Buys Truck Tires

WHEN the army buys truck tires it gives special attention to the rubber compound.

As you perhaps know, rubber like gold or metal or hides, needs chemical assistance to make it practicable. Pure rubber truck tires would be a tragedy. So the manufacturer, in his laboratory, compounds or mixes materials to give the rubber toughness and vitality without sacrifice of elasticity.

And he who compounds most skilfully produces the BEST truck tire, the most lasting!

In this respect, don't you think the fact that Goodrich was the *only* manufacturer to deliver tires direct from the stock—when the government asked for truck tires—without changing the compound to meet government specifications speaks volumes for Goodrich Truck Tires, the product of a half-century of rubber experience?

THE B.F.GOODRICH RUBBER COMPANY
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His Health is your Biggest Asset

Half-sick men at work use power, machinery, materials and get full wages—but their work is uncertain and their output low.

Faulty physical surroundings are responsible for many of the ills your employees suffer. Defective and insufficient toilet accommodations, uninviting washrooms, inaccessible drinking water—all tend to lower vitality and reduce the high-speed performance so necessary to strike a telling blow in the world war.

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has made many toilet rooms sanitary, economical to maintain, and permanent. Permanency is not denoted by a white surface but by what material is beneath that surface and how conscientiously it was made. With time, inferior materials will lose their sanitary value, dirt will adhere, the appearance become uninviting—the piece loses its usefulness.

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war will not permit the waste of manpower nor the eruption of smokestacks with atoms which might be turned toward the destruction of a savage foe. The military art both slays and saves. War wrings wealth from waste; turns prodigality to thrift; transforms pests to profit.

The Liberty Motor

(*Continued from page 455*)

strengthen the crank case and reduce vibration. The cylinders are of 5 by 7 bore and stroke and have a cubic capacity of 905 inches. The motor has individual cylinder barrels and stamped steel water jackets. This construction permits of machining the barrels all over so as to have uniformity of section and a maximum of strength with a minimum of weight. The stamped steel jackets insure uniform water space and absence of steam pockets. The jackets are welded to flanges formed on the cylinder, the cross sectional area of the flanges being the same as that of the jackets so that both members can be brought to an equal degree of temperature, thus facilitating the welding operation. The valves in the head are set at an angle to insure the best shape of combustion chamber and the maximum possible valve size. To shorten the travel of the gases the inlet valves are on the inside, while the exhaust valves are on the outside and carry off the hot gases rapidly from the valves and motors. There is a single cam shaft for each set of cylinders which is mounted between the valve stems, providing a very simple and direct action. Double valve springs are used to minimize breakage from vibration. There are two duplex carburetors, each bore serving three cylinders so as to give the best distribution of gas and to permit of ready and accurate synchronization. Pressure lubrication is used on all plain bearings. The oil supplied to the connecting rod bearings and cylinders is controlled by metering conduits in the main and connecting rod bearings. The pistons are an aluminum alloy chosen for lightness and good heat-conducting properties. There are two spark plugs for each cylinder so as to halve the possibility of losing a cylinder due to spark plug trouble and in order to increase the rapidity of the flame propagation in the cylinders.

The future of the Liberty motor is a problem that is occupying a great deal of attention at the present time. It is not a power plant that can be used in automobiles or trucks. Its power is far greater than anything now required in such service. The motor might be used for racing motor boats, but it is distinctly an airplane engine built as an emergency measure for war purposes. No doubt a large stock of the motors now on hand will be retained by the Government for the development of the air service of the Army and Navy which will have to be maintained on a large scale as long as the possibilities of war confront us. Airplanes will also be used in rapidly increasing numbers for postal service and no doubt to a considerable extent for pleasure, because the vast army of young men who have learned to navigate the air will not be content to remain on the ground.

The Surrender of the German Fleet

(*Continued from page 459*)

"Koenig," "Grosser Kurfuerst," Markgraf" and "Kronprinz Wilhelm." These are of about 26,000 tons displacement and 20.5 knots contract speed. They mount 10 12-inch, 45-calibre guns, 14 5.9-inch, 10 3.4-inch and two 14-pounder automatics. Like the "Bayern" they are driven by turbines operating three screws. On all of these ships the belt is just under 14 inches in thickness, the same thickness of armor being carried on the turrets, with 15 inches on the fore conning tower and 10 inches on the after conning tower. The main belt is 14 feet deep and the sides above the belt, between the forward and after barbettes, are protected by six inches of armor. The "Koenig," of this class, was to have been surrendered, but was in dry-dock at the time and could not be moved. These ships were completed in 1914 and 1915.

The next class consists of the five ships "Kaiser," "Friedrich der Grosse," "Kaiserin," "Prinz Regent Luitpold" and "Koenig Albert." The displacement is 24,500 tons, the horse-power 28,000 tons, and the contract speed 20.5 knots. It has been stated that these, in common with all the later battleships of the German navy, have made considerably more than 20.5 knots on trial. They are armed with 10 12-inch, 50-calibre guns, 14 5.9-inch and 12 3.4-inch and two 14-pounder anti-

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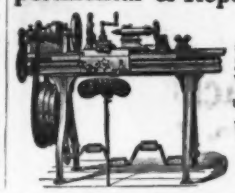

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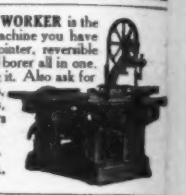

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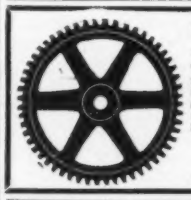

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aircraft guns. The ships of this and the "Koenig" class all carry five submerged torpedo tubes which fire the latest 22-inch German torpedo.

Of the six battle-cruisers given up on the signing of the armistice, only five were surrendered to Admiral Beatty. These are the "Hindenburg," completed during the war and of about 28,000 tons and of a speed of about 28 knots. She carries eight 12-inch, 50-calibre guns, 12 5.9 inch, 12 3.4-inch and several anti-aircraft guns. Her torpedo outfit consists of five submerged tubes for firing the 22-inch torpedo.

The "Derfflinger," 26,500 tons and about 28 knots, carries eight 12-inch, 12 5.9-inch, 12 3.4-inch, and the usual anti-aircraft guns. The torpedo armament is similar to that of the "Hindenburg." This ship and the "Hindenburg," by the way, follow the American plan of mounting of the guns on the longitudinal axis of the ship. There are two turrets forward and two aft with superposed fire. In both of these ships, the belt armor has always been reputed to be 12 inches as against the usual six to eight inches on the battle-cruisers of other navies. Whether this claim is correct we are not in a position to say at the present writing.

The "Seydlitz" and "Moltke" are practically sister ships, the former being of 25,000 tons, and the latter of 23,000 tons displacement. They are credited with an 11-inch belt and each carries a battery of 10 11-inch, 12 5.9-inch and 12 3.4-inch guns, with respectively five and four submerged torpedo tubes. The arrangement of the battery is one turret forward, one turret on each beam, placed *en echelon*, and two superposed turrets aft. The "Moltke" is familiar to residents of New York, where she lay for some weeks in the North River during a celebration in pre-war times. Both ships are credited with a speed of 28 knots on trial.

The "Von Der Tann," it seems, was not lost during the war, as came to be generally supposed. She was completed in 1910 and is a considerably smaller vessel than the other battle-cruisers, her displacement being just under 20,000 tons. Her belt armor is nine inches and she carries an armament of eight 11-inch, 10 5.9-inch, and 16 3.4-inch guns, together with the usual torpedo battery.

The other battle-cruiser of the six surrendered on the signing of the armistice is the battle cruiser "Mackensen." This vessel is not yet ready for sea and is to be given up at a later date. She is probably a sister ship to the "Hindenburg." The British fleet has left for Wilhelmshaven and Kiel to receive the surrender of these two vessels.

Among the scout cruisers surrendered are two recently commissioned vessels, the "Bremse" and "Brummer," which have been designated as mine-laying scouts. They are of 4,100 tons displacement and 35-knot speed. They carry a battery of four 5.9-inch and eight 4.1-inch guns, and probably some anti-aircraft pieces. They are credited with a capacity, each, of 480 mines. Then there are the four ships of the "Emden" class, namely, "Emden," "Karlsruhe," "Nürnberg," and "Frankfurt." These are of 5,400 tons, 30 knots, mount 10 5.9's and four 14-pounder anti-aircraft guns. Each carries 120 mines. The other two ships of the eight (not yet given up), are the "Koln" and possibly the "Koenigsburg." The "Koln" is a new ship believed to be of 6,300 tons displacement and 33-knot speed, mounting two 8.2-inch and six 5.9-inch guns. The "Koenigsburg" is the ship that took the German naval peace delegates to the grand fleet. She is believed to be a vessel of the "Emden" type.

The armistice terms called for the delivery of 50 destroyers and 160 submarines. The 50 destroyers were delivered to Admiral Beatty on November 21st, and at the present writing 100 submarines, including the U-153, which was formerly the merchant ship, "Deutschland," have been surrendered and interned at Harwich on the east coast of England. Among these vessels were included several of the large cruiser submarines of which we have heard so much of late.

Gun Camouflage

(*Continued from page 460*)

destinies of ships which look as if some Brobdingnagian infant had painted them. Artillery officers were aghast at the idea that yellow and blue and green paint should be slopped on their shining guns, or that the dull green or khaki brown of mounts should be defaced with such spots as would make a leopard and a zebra laugh in their faces.

But nothing of that now. Guns go into position looking like futurist nightmares. Moreover they go into position made a thousand times more visible to the observer, close by than if painted in monotone—and this was the hardest thing for the officer untrained in camouflage art to understand. United States guns and trucks are painted with cream, yellow and green. They are painted in small blotches, which blend into one color at a distance, but in bold waving outlines. Moreover, the colors do not touch at the edges but are separated with heavy black bands of paint. Yet the result is that at a distance the eye sees the prominent outlines of the colors and not the outlines of the gun. If these outlines, then, are seen against yellow earth or green foliage, they become inconspicuous and—the gun is invisible. There is no magic about it—it is simply distraction. The eye is kept from seeing the *gun* by being made to see heavy wavy outlines of colored *paint*. And it fails to distinguish the *paint* in its wavy outlines because that paint is swallowed up in the colors of the surroundings. It is the prominence of the Zebra which disappears in sunlit reeds, the riot of color of the butterfly which fades from view when he lands upon a flower, the conspicuous mottling of the snake or the lizard which is never seen against the old mossy stump or trees, transplanted into terms of guns and warfare.

The science of concealment by imitation has gone so far as to analyze the colors to be used, and it is strictly enjoined that paints should be similar in color to the colors found in the surroundings in which the camouflage is to be effected. Grass, for instance, is green to the eye. But it contains some red. If a piece of burlap, for instance be painted with green paint which is all green, even if it matches the green of the grass perfectly, a photograph made with a color filter will at once show that the green is not a real match. No battery commander is satisfied his camouflage is effective until it has been photographed in several different lights from several different altitudes. Even the chicken wire used for overhead screens must be painted as well as camouflaged, otherwise it makes a blue haze among the trees, easily seen from aloft.

But by no means all coloring in camouflage is by means of paint. If it is possible to paint with mud, mud is used. Green bushes match better with green bushes than green paint, and grass matches better with grass than a painted rafia screen. So wherever possible the natural objects are used, both in simulating others and in taking the place of those which have to be removed or displaced to make the emplacement. Formerly a military work was supposed to be regular and even, a matter of right lines. Now the less regularity there is about a battery position the easier it is to conceal.

One of the difficult problems is the disposal of earth which must be excavated to make an emplacement. The best solution is the big shell hole—and shell holes on the front are not difficult to find. If a shell hole isn't available there are usually excavations from which dirt has been taken in peace times for one purpose or another. It has been discovered by photography that considerable dirt may be put into a hole without changing its appearance much if at all, when photographed. So the wheelbarrow is used, and the dirt from the emplacement is wheeled over ex-paths to such a place and dumped, care being taken that if an enemy plane appears the men and the barrows hide. If there is no hiding place, the work is done after dark.

Nor is camouflage all coloring and screening. Like the dummy battery, which functions in two ways—both by drawing attention from the real battery and by providing one of two objects to be shot at, thus halving the shots which must come to the real battery—gun emplacements are often made to look like something else. A trench mortar emplacement may, by paint, be made to be a shell hole. Blast marks may be sodded at frequent intervals and observation may be prevented by covering the ground under the muzzle when firing, or they may be covered from observation with a camouflage screen. A gun emplacement may be concealed by being made a conspicuous trench system, abandoned.

Side Lights on Rehabilitation

(*Continued from page 461*)

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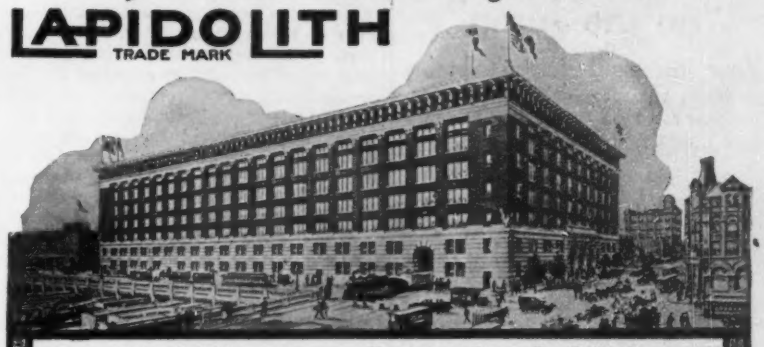

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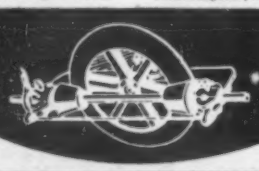

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never notice them. No more does anybody go out of his way to assist; from now, the man with a wooden leg is strictly dependent on his own resources.

These are usually decidedly limited; the man of whom we speak is, for the most part, young and sadly lacking in practical experience. In the situation outlined, he becomes a sort of temporary paranoiac, drifting along with the tide for a time, bitter at the world for having turned against him. Eventually, if he does not become completely submerged, he wakes to the facts as they are. He realizes that the world holds for him a living, but that he must work for it. Right here he becomes a better citizen in many respects than before his misfortune; and when given the opportunity he will almost invariably make good. But often this very opportunity is denied him, because of the tendency to think of him as incapacitated by the loss he has suffered, and therefore to refuse him a fair trial.

The significance of all this in connection with the crippled soldier is obvious. We must not make the same mistake with reference to him that we so generally make with reference to his prototype in civil life. Nor must we let him make the same mistake with reference to himself. He is neither an outcast nor a pet, and he must not be permitted to get the idea that he is either. He must be educated, not merely to the physical side of his new calling, but also to the necessity and the propriety and the dignity of his engaging in that calling. He must be brought to realize that we are anxious to put him on a footing of equality with whole men, but no more.

In its turn, the public must come to see that good industrial service from the crippled soldier is essential both to the soldier and to society. Like all other members of the community, the man who has been partly disabled is to be given every opportunity to engage in work for which he is qualified. The only distinction is that the cripple must have assistance in qualifying, and perhaps first call at the work for which he has qualified. Only by avoiding the mistakes made by society in its treatment of the civilian cripple, and by this cripple in his outlook upon society, can we escape being saddled with a heavy load of discontented semi-incompetents and useless pencil-peddlers for many years after the war. It is not merely in our own interests that we wish to avoid this, but equally in the interests of the men who would constitute that load.

The proper choice of an occupation for a maimed man is a matter calling for the most careful consideration of every factor. Most important, of course, is the nature of the injury. The guiding principle in selection of an occupation is that with shorter stump and with both legs off we find increasing inability to move about rapidly and with precision, or even to stand for any great time. Consequently as we go up the scale of disability we must provide work which more and more permits the worker to sit down in one place and stay there. In the extreme cases, among the trades indicated are those of the telegrapher, the cobbler, the office worker; and many types of automatic machinery are such as to permit the operator to be stationary and seated. Finally, whatever the condition of a man's legs, if his fingers have not been made all thumbs by long confinement to heavy unskilled labor, he is capable of learning shorthand and developing speed on the typewriter.

So much for the man who loses a leg. But the men who come back from France with one arm or none will be much more seriously crippled, from an industrial standpoint, than those whose loss is confined to the lower limbs. Fortunately, they will not be so many; on the basis of Canadian figures, hardly two-thirds as many. For while men receive leg wounds and arm wounds in about equal proportions, a man with a shattered arm can often take himself out of the fight and to the nearest dressing station under his own power; but a man with a leg out of commission must stay right where he is until it is possible for bearers to come and get him. This delay in getting to a place where first aid measures can be applied often causes the consequences of a leg wound to become more serious than it would naturally be, so that amputation of the leg is more frequent than of the arm.

The industrial efficiency of a man who loses an arm is at once so reduced that he sinks into or below the class of unskilled labor. Men who can earn their living with their heads are of course not thus affected; a man with brains and will power and a reasonably adequate training will not be kept down by any disability. But those who are forced to depend upon their two hands to make their way in the world know that with only one of them they can not go far. A job as doorman or caretaker or errand boy is about all that such a man can hope for, unless he can be provided with a practical working substitute for his lost arm, and trained to use it.

The old-fashioned idea of an artificial arm was merely a piece of wood or leather in the shape of a hand and arm. This may look like an arm, but it doesn't do the work of one. It is satisfactory enough to the clerk who can do his work with one hand and wishes something to conceal his deformity; but for the man who has to grasp a tool it is useless. The successful arm for the manual worker is the one based on the idea that it is not an imitation arm which is wanted, but rather a tool-holder. It will not remotely resemble an arm in appearance; but the proportion of the work of a hand and arm that it will do is amazing.

The mechanical tool-holder, or as the surgeons call it, the working prosthesis, should be designed to do the work of the less active, or helping hand—in right-handed persons the left one. If it is the right hand that is gone, the left takes its place as the active hand, being in turn supplanted, in its old function of supporting the tool, by the artificial member.

We will not go into mechanical details, since we have previously shown a sufficiency of the representative types. It is the hand itself that presents the critical problem. There must be some means of grasping a spring, a set-screw operated by the good hand, etc. The arm and "hand" are modelled according to the work to be done and the tool to be grasped; in its turn, this tool is designed with special reference to the fact that it is to be used by a man with a metal jaw in place of a hand, a man well able to hold on, but not to seize and let go with ease. Thus special arms and hands are furnished in France for laborers, vine growers, postmen, chair caners, leather cutters, general mechanics, packers, carpenters, jewelers, drivers of animals, motor drivers, machinists, stone-cutters, printers. Men of these trades are frequently trained to return to them, with complete success; men of other trades which are believed to call for too delicate work with the secondary hand are with equal success initiated into one of the trades named, in which that hand is called upon for little more than support of the tool.

The efficiency of any working arm depends largely upon the length of the stump. If the elbow joint and the power to move it are conserved, the hand will of course have more power and more extensive limits of motion. If the elbow joint is a mechanical one, it must be fixed in each position by jam-nut, lever or screw, with consequent loss of time, mobility and strength. An effective working arm is, in general, out of the question if less than a third of the upper arm remains to impart motion to the attached member.

The immediate interest of scientific prosthesis and reëducation, is of course, in connection with the war. But in the nature of things, this can be but temporary; there will come a day when the cripples of the Great War are no longer present. The apostles of the new science point out that their work will outlive the immediate necessity which has given rise to it. There are certain always to be a quantity of cripples as the result of accident.

Another field which we may expect to be permanently occupied is that held by the man who examines the war cripple and prescribes for him the employment which he will best be able to follow. Is it trespassing too much upon the sacred rights of the individual to look forward to a day when the privilege of wasting his efforts in work for which he is not fitted will be denied him? It is within the bounds of reason to predict that the present advances in reëducation are but the forerunners of still greater strides to come, strides which will at least make it possible for us to direct all those who are physically or mentally sub-normal into the callings for which they are least disqualified, and which at their highest development would enable expert examiners to present to every human being a list of half a dozen occupations in which his success would be a maximum. Under such a dispensation, we would be done with the forced conversion of potentially excellent blacksmiths into doctors and lawyers and engineers, and with the loss of super-mathematical intellects through condemning their possessors to work in a coal mine.

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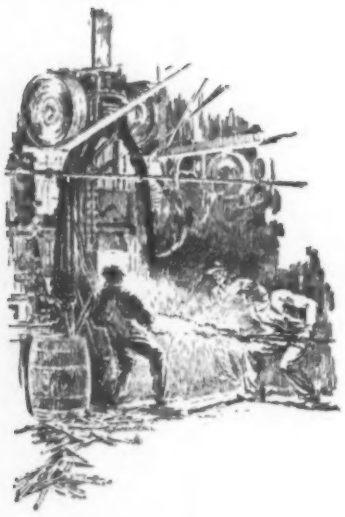

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THE GREATEST OFFENSIVE WEAPON OF THE WAR: THE IRRESISTIBLE ALLIED TANK [See page 475]

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December 14, 1918

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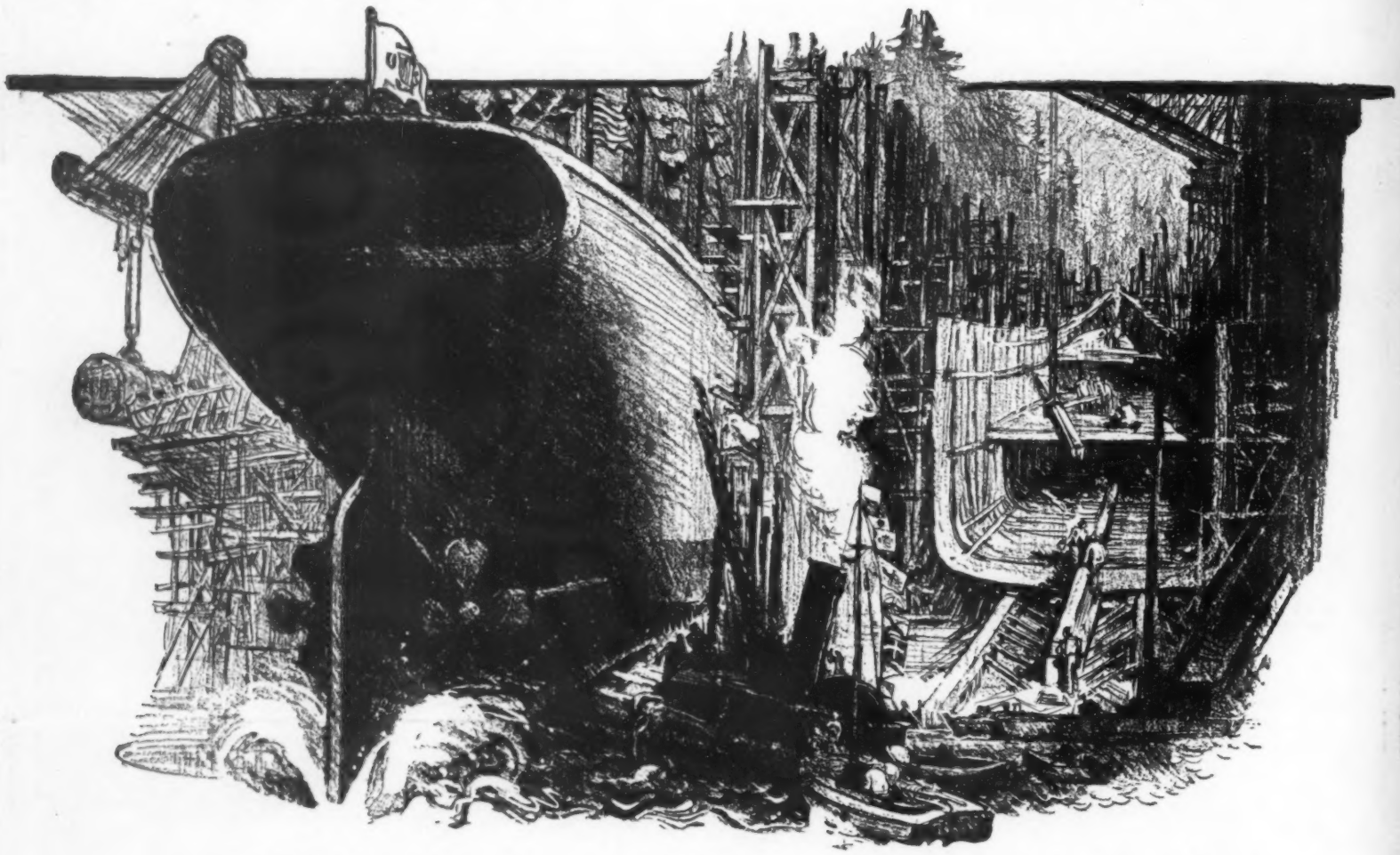

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Many are the problems in control and motor application. Industrial engineers and managers place their needs before the General Electric Company, whose engineering and manufacturing facilities are broad enough and big enough to give the answer in record time, so that the great war program may not be interrupted.

It is for America's manufacturing and industrial efficiency that such an organization as the General Electric Company is maintained. It is to the interest of the country as a whole that industry avail itself of the opportunity to consult with the industrial engineers of the General Electric Company; for many a perplexing production problem can be solved by the correct application of electric power —sometimes without adding to the present electrical equipment.

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GENERAL ELECTRIC COMPANY

The Scientific American for 1919

TO THE SCIENTIFIC AMERICAN, the year 1919 means much. First of all we are entering an era of peace and intensive industrial effort, following the greatest war of all ages. Reconstruction and reclamation projects on an undreamed of scale are to be inaugurated within the next twelve months. Marvelous inventions are to be disclosed to a curious world. Scientific discovery and research, which have been dormant during the past four years of strife, bloodshed and appalling destruction, are again coming into their own. So the year 1919 is a great year for the SCIENTIFIC AMERICAN, which has ever been the chronicle of worthy achievements since its founding in 1845.

Flexibility of Editorial Policy

It is fortunate indeed that the SCIENTIFIC AMERICAN has always maintained a certain flexibility in its editorial policy. Thus when the great war broke out in Europe, almost overnight, as it were, this journal immediately adapted itself to the changed order of things. During the past four years it has been giving its readers timely and authentic news concerning the war and the ever-changing tactics of trench and open warfare. Yet the SCIENTIFIC AMERICAN never lost sight of the fact that there still remained other subjects of interest aside from war. It retained its editorial balance throughout the worldwide strife; it held to its policy of practical service.

Thus the SCIENTIFIC AMERICAN was among the first periodicals to urge national preparedness for war, and it was the first to urge national preparedness for peace. The war had barely started before we realized that there would be a critical period of reconstruction following the war, and that preparations must be made for that trying time. We have now reached the reconstruction period. And the SCIENTIFIC AMERICAN, still retaining its flexibility of editorial policy, has turned to the problem of again placing things in order in this old world of ours. It means to do its full share toward the readjustment of economic and industrial conditions.

What About Reconstruction?

The American manufacturer, who has built up a vast organization for the production of war materials, is now faced with the question of either scrapping his plant and discharging all his employees or taking up some new line of manufacture which will enable him to continue the operation of his organization. In the search for a new line of manufacture or for some new invention adapted to be manufactured in their plants, many manufacturers have written to the Editor of the SCIENTIFIC AMERICAN for help. Accordingly, seizing on this subject of the moment, we have opened a *Reconstruction Department* in which appeals of this nature may be brought to the attention of the responsive SCIENTIFIC AMERICAN audience of readers. Our Reconstruction Editor will be glad to aid manufacturers in every way possible.

In the further interests of reconstruction we are studying the methods that are being employed abroad, and also the plans of our own Government and American business men; and we are preparing helpful articles to clear up the vexing problems of those difficult days which confront us. Not only will these articles deal with economic conditions at home and abroad, but with the actual physical conditions of reconstruction in the devastated regions of Europe.

The New Renaissance of Scientific Research

It is true that the war has stimulated a wider interest in matters of science that ever before. So it has come to pass that the business man of today realizes that he must keep in touch with the latest progress of science, and that this information should be disseminated throughout the land in order to keep American commerce in the forefront. There is no longer the aversion to the university man as a mere theorist.

What has the SCIENTIFIC AMERICAN to do with all this? In order to keep in touch with the march of progress in science and engineering, we answer, the SCIENTIFIC AMERICAN has established corresponding editors in the principal universities maintaining research laboratories. From these sources interesting reports will be published from time to time, dealing with the latest advances in science and their probable bearing on articles and processes of manufacture.

Inventors and Inventions

So, too, are we entering upon a new era of invention. Inventors are readjusting their thoughts to the conditions of peace. The world is more ready than ever before to try out new ideas. The war has broken down much of the conservatism that proved a bar to creative thought in times past. During this new era of invention, the SCIENTIFIC AMERICAN will be the best medium for getting the manufacturer in touch with new ideas that may vitally affect his business, and keeping the inventor informed as to the manufacturer's requirements.

The Opportunities of Foreign Trade

Then there is the great subject of foreign trade, with which we Americans have finally become acquainted through the agency of the war. After we recovered from the first shock of trying to get along without Europe, we found the markets of the world wide open to us and a large foreign buying public virtually crying for American products. This led to a broadening of our commercial horizon, which has continued to expand despite the necessary restrictions of war that later were placed upon our exports. Now that these restrictions are being withdrawn, we are confronted with other problems, namely, those of competition with experienced European exporters.

In a department devoted to *World Markets for American Manufactures*, these problems are discussed in a condensed form so that they may be grasped readily by the man who has no time to peruse long articles. The department tells of the needs of foreign markets and the opportunities they offer for American goods. To the end that this information may be all encompassing, the SCIENTIFIC AMERICAN has correspondents in all parts of the globe.

Revealing the Secrets of the War

It has always been evident that the entire story of the war had not been told up till the signing of the armistice. On land and on sea and in the skies there have been numerous devices and ideas which have been zealously guarded by both sides, lest they should fall into enemy hands and be turned against the original users. But with the signing of the armistice and the terminating of hostilities, one after another these marvelous devices and ideas are making their way into the columns of the SCIENTIFIC AMERICAN. Many of them have been held in the editorial offices, awaiting the sanction of the various government officials, while others are now being sought at home and abroad.

While much space will be occupied with the accounts of the progress of science and its application to the industries, there is still a good deal to be told about the war. And the SCIENTIFIC AMERICAN means to publish the erstwhile military secrets for the benefit of its readers, thus rounding out and completing its technical story of the great war.

Our Staff of Correspondents and Our Field Editor

With correspondents in every part of the United States and in many of the leading countries of the world, the SCIENTIFIC AMERICAN has always been in a position to give its readers the latest practical information from the four corners of the earth. In addition to the large staff of correspondents, we now have a Field Editor on our immediate staff whose duty it will be to travel about in search of that material which is hidden in out-of-the-way places, along with the really big things which are in plain view of everyone. Armed with camera and notebook and other reportorial facilities, the Field Editor will bring to the columns of the SCIENTIFIC AMERICAN numerous photographs and articles on the really big and important and unusual things which have to be hunted down to their very lair.

The New Dress and Size of the Scientific American

From its present size which has been standard for so many years, the SCIENTIFIC AMERICAN will be published in a new and smaller size beginning with the first issue of 1919. The smaller size will make it far more convenient to handle, and, because of the added number of pages, will permit of covering a wider range of subjects in each issue. To those readers who have been subscribing to the journal, it must no doubt be a welcomed piece of news to learn that the SCIENTIFIC AMERICAN in the new size will be mailed with but one fold, instead of being rolled as heretofore.

The SCIENTIFIC AMERICAN in its new size and dress will present numerous innovations while retaining those features which have brought it a large and staunch army of friends. It will continue to be, during the year 1919,

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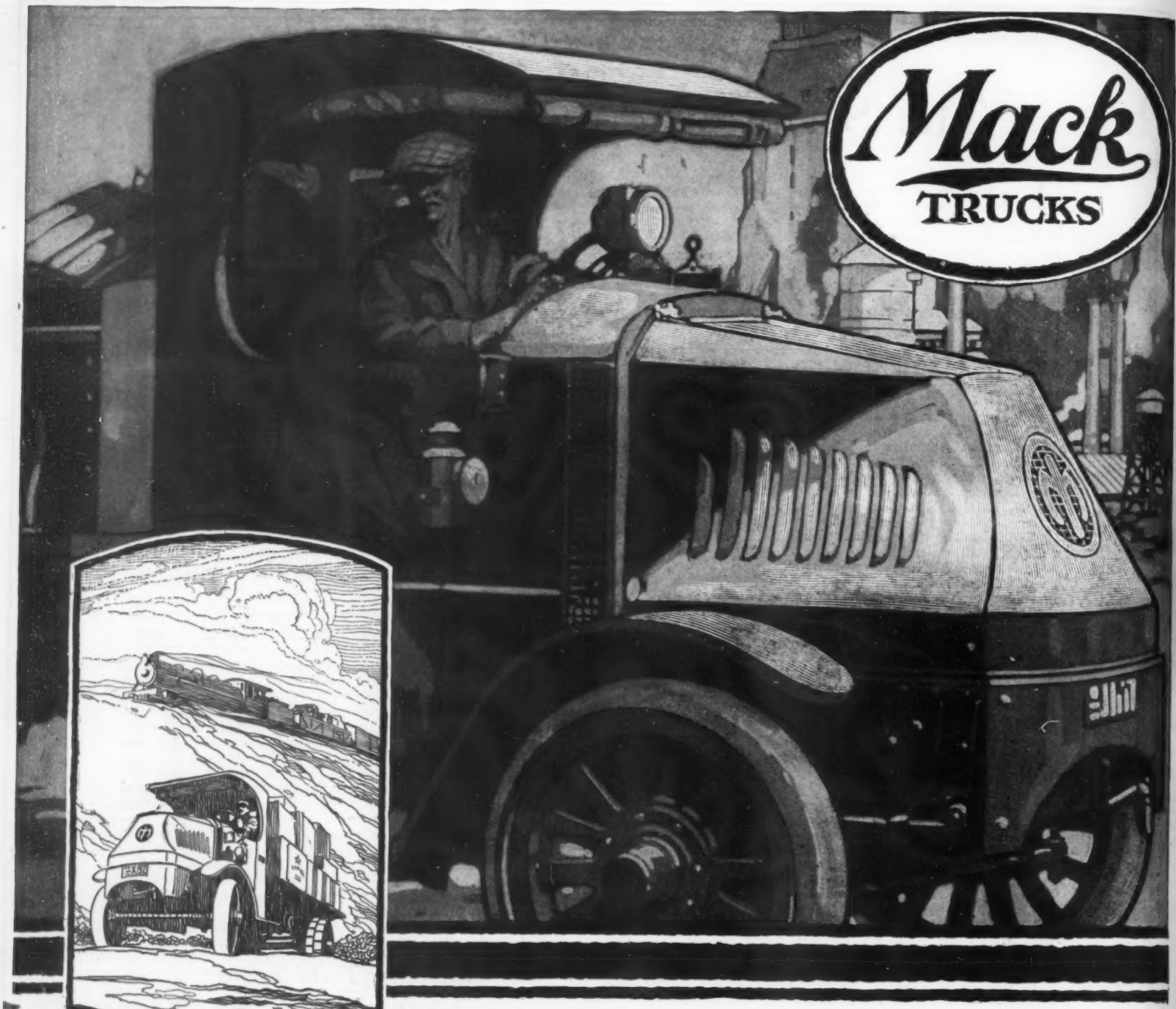

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